Clean Water Act Section 319(h) Nonpoint Source Pollution Control Program

Surface Water Quality Monitoring to Support the Implementation of the Plum Creek Watershed Protection Plan

TSSWCB Project 19-06
Revision 0

Quality Assurance Project Plan

Texas State Soil and Water Conservation Board

Prepared by

Guadalupe-Blanco River Authority

Effective Period: Upon EPA approval through August 31, 2022
with annual revisions required

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A1 APPROVAL PAGE

Surface Water Quality Monitoring to Support the Implementation of the Plum Creek Watershed Protection Plan

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Title: Ana-Lab Quality Manager

Signature: ______________________________ Date: ________________

Sub-tier participants (e.g., subcontractors, subparticipants, or other units of government) will sign this QAPP, indicating the organization's awareness of, and commitment to requirements contained in this quality assurance project plan and any amendments or added appendices of this plan. Signatures in section A1 will eliminate the need for adherence letters to be maintained.

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List of Acronyms

Ana-Lab	Ana-Lab Corporation Environmental Laboratory
AWRL	Ambient Water Reporting Limit
BMP	Best Management Practice
BOD	Bio-chemical Oxygen Demand
C	Centigrade (Temperature)
CAR	Corrective Action Report
CBOD	Carbonaceous Biological Oxygen Demand
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
COC	Chain of Custody
COD	Chemical Oxygen Demand
CR	County Road
CRP	Clean Rivers Program
CWA	Clean Water Act
DO	Dissolved Oxygen
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
GBRA	Guadalupe-Blanco River Authority
GIS	Geographic Information System
GPS	Global Positioning System
H_2SO_4	Sulfuric Acid
ID	Identification
L	Liter
LCS	Laboratory Control Standard
LOD	Limit of Detection
LOQ	Limit of Quantitation
m	Meter
mg/L	Milligrams per Liter
mL	Milliliters
MPN	Most Probable Number
NA	Not Applicable
NELAP	National Environmental Laboratory Accreditation Program
NH_3-N	Ammonia-Nitrogen
NO_3-N	Nitrate-Nitrogen
NWIS	National Water Information System
NCR	Nonconformance Report
NRCS	U.S. Department of Agriculture Natural Resources Conservation Service
OSSF	On-Site Sewage Facility
PCWP	Plum Creek Watershed Partnership
QA	Quality Assurance
QASM	Quality Assurance System Manual
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
R	Recovery (%Percent Recovery)
RL	Reporting Limit
RPD	Relative Percent Difference

SA	Sample Amount (reference concentration)
SARA-EL	San Antonio River Authority - Environmental Laboratory
SLOC	Station Location
SM	Standard Methods
SOP	Standard Operating Procedure
SR	Sample Result Concentration (%Percent Recovery)
SSR	Spiked Sample Concentration (%Percent Recovery)
su	Standard Units
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System (formerly TRACS)
TCEQ	Texas Commission on Environmental Quality
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
TSWQS	Texas Surface Water Quality Standards
TWQI	Texas Water Quality Inventory
USGS	U.S. Geological Survey
WPP	Watershed Protection Plan
WQMP	Water Quality Management Plan
WWTF	Wastewater Treatment Facility

A3 DISTRIBUTION LIST

Organizations, and individuals within, which will receive copies of the approved QAPP and any subsequent revisions include:

EPA
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Title: GBRA Project Manager/Data Manager

Name: Jana Gray
Title: GBRA Field Technician/Backup Data Manager
Name: Kylie Gudgell
Title: GBRA Laboratory Director

Name: Michelle Robertson
Title: GBRA Laboratory QAO

Ana-Lab Corporation
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Name: Tracy Varvel
Title: Ana-Lab Quality Manager

The GBRA will provide copies of this QAPP and any amendments or appendices of this QAPP to each person on this list and to each sub-tier project participant, e.g., subcontractors, other units of government, laboratories. The GBRA will document distribution of the QAPP and any amendments and appendices, maintain this documentation as part of the project's QA records, and will be available for review.

A4 PROJECT/TASK ORGANIZATION

The following is a list of individuals and organizations participating in the project with their specific roles and responsibilities:

EPA

Anthony Suttice, EPA Project Officer
Responsible for managing the project for EPA. Reviews project progress and reviews and approves QAPP and QAPP amendments.

TSSWCB

Liza Parker, TSSWCB Project Manager
Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Provides the primary point of contact between the GBRA and the TSSWCB. Tracks and reviews deliverables to ensure that tasks in the workplan are completed as specified in the contract. Responsible for verifying that the QAPP is followed by the GBRA. Notifies the TSSWCB QAO of significant project nonconformances and corrective actions taken as documented in quarterly progress reports from GBRA Project Manager.

Mitch Conine, TSSWCB QAO
Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants. Assists the TSSWCB Project Manager on QA-related issues. Coordinates reviews and approvals of QAPPs and amendments or revisions. Conveys QA problems to appropriate TSSWCB management. Monitors implementation of corrective actions. Coordinates and conducts audits.

GBRA

Lauren Willis, GBRA Manager of Environmental Science
Provides technical assistance to the GBRA Project Manager/Data Manager, GBRA Laboratory Director and GBRA QAO regarding compliance with the project workplan.

Lee Gudgell, GBRA Project Manager/Data Manager
Responsible for implementing and monitoring requirements in the contract, and the QAPP. Responsible for writing and maintaining records of the QAPP and its distribution, including appendices and amendments. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Coordinates project planning activities and work of project partners. Ensures monitoring systems audits are conducted to ensure QAPP is followed by project participants and that project is producing data of known quality. Ensures that subcontractors are qualified to perform contracted work. Ensures that quality-assured data is posted on GBRA Internet sites. Ensures TSSWCB Project Manager and/or QAO are notified of deficiencies, non-conformances, and corrective actions, and that issues are resolved. Responsible for validating that data collected are acceptable for reporting to the TCEQ SWQMIS.

Responsible for coordinating sampling events, including maintenance of sampling bottles, supplies, and equipment. Maintains records of field data collection and observations. Responsible for ensuring that field data are properly reviewed and verified for integrity and continuity, reasonableness and conformance to project requirements, and then validated against the data quality objectives listed in this QAPP. Responsible for the transfer of project quality-assured water quality data to the SWQMIS Test database (the validation algorithm) to obtain a validation report, then submitted electronically to the TSSWCB Project Manager and TCEQ Data Management and Analysis Team. The GBRA Field Technician will assist with completion of the job tasks of the GBRA Data Manager when delegated by the GBRA PM.

Jana Gray
Guadalupe-Blanco River Authority Field Technician/ Backup Data Manager
Performs field data collections for project as specified in Appendix A. Notifies the GBRA Quality Assurance Officer and GBRA Laboratory Quality Assurance Officer of particular circumstances, which may adversely affect the quality of data. Serves as a backup for the duties of the GBRA project manager (PM)/Quality Assurance Officer (QAO)/data manager (DM) when delegated by the primary PM/QAO/DM. The backup data manager responsibilities include assisting with the review and verification of laboratory and field data for integrity, continuity, reasonableness and conformance to project requirements, and validation of data against the measurement performance specifications listed in this QAPP. Assisting with the transfer of basin quality-assured water quality data to the TSSWCB and TCEQ in a format compatible with SWQMIS. Assisting with upload of quality-assured data to the GBRA internet sites. Assisting with the preparation of corrective action plans and quarterly progress reports to the TSSWCB Project Manager. The GBRA Project Manager will assist with completion of the job tasks of the GBRA Field Technician

Kylie Gudgell, GBRA Laboratory Director
Responsible for overall performance, administration, and reporting of analyses performed by GBRA Laboratory. Responsible for supervision of laboratory personnel involved in generating analytical data for the project. The responsibilities of the GBRA laboratory technical director include supervision of laboratory, purchasing of equipment, and supervision of lab safety program. Ensures that laboratory personnel have adequate training and a thorough knowledge of this QAPP and related SOPs. The GBRA Laboratory QAO will assist with completion of the job tasks of the GBRA Laboratory Director when delegated by the GBRA Laboratory Director.

Michelle Robertson, GBRA Laboratory Quality Assurance Officer
Responsible for coordinating the implementation of the QA program. Responsible for identifying, receiving, and maintaining QA records. Notifies the GBRA Laboratory Director and GBRA Project Manager of particular circumstances which may adversely affect the quality of data. Coordinates and monitors deficiencies and corrective action. Coordinates and maintains records of data verification and validation. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Additionally, the QAO will review and verify all laboratory data for integrity and continuity, reasonableness and conformance to project requirements, and then validated against the data quality objectives listed in this QAPP. The GBRA Laboratory Director will assist with

completion of the job tasks of the GBRA Laboratory QAO when requested by the GBRA Laboratory QAO.

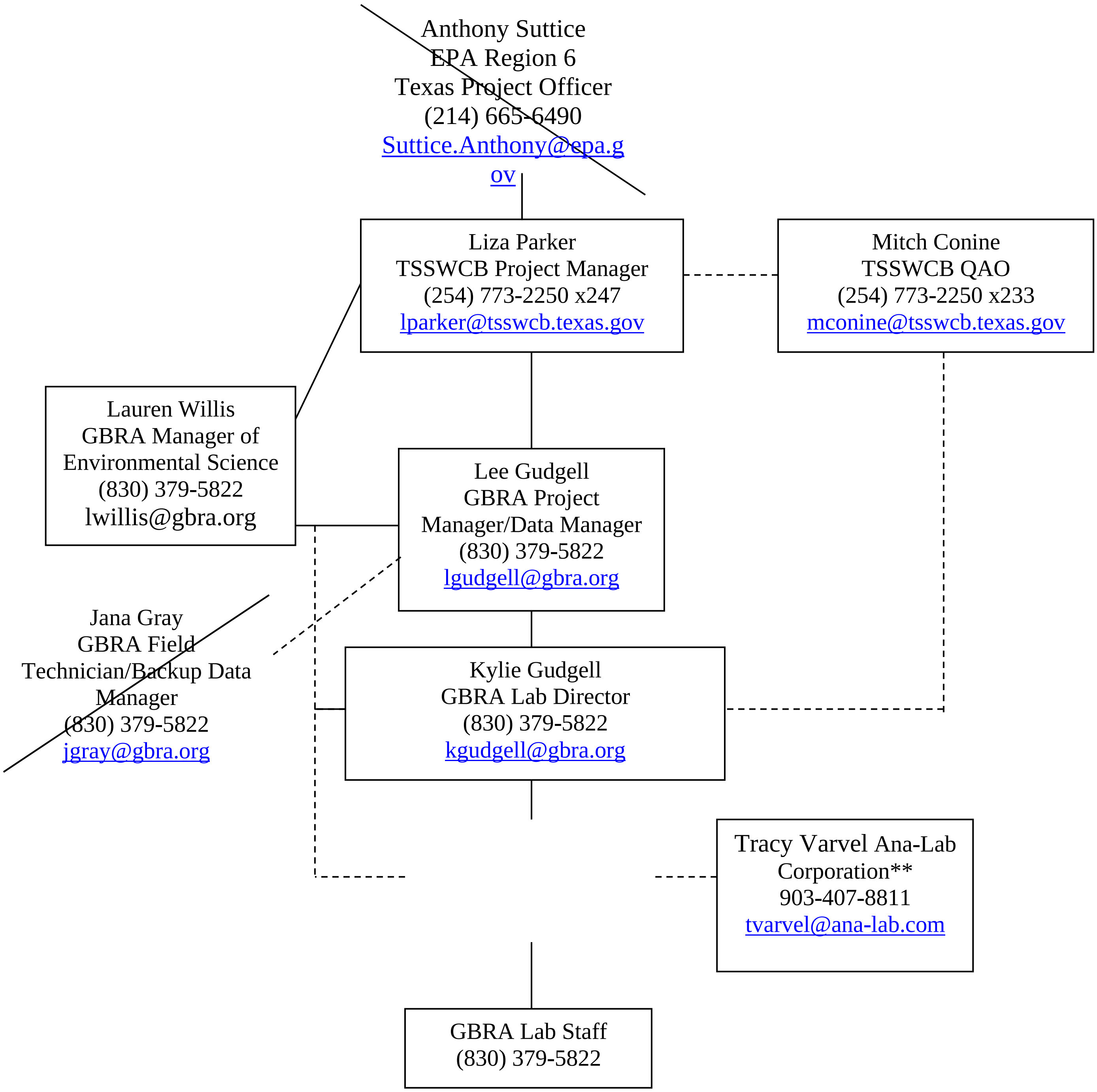
Laboratory Technicians (6)
Perform laboratory analysis for inorganic constituents, nutrients, etc.; assist in collection of field data and samples for stream monitoring and chemical sampling of environmental sites. Perform sample custodial duties.

Ana-Lab Corporation Environmental Laboratory

William Peery, Ana-Lab Laboratory Technical Director
The responsibilities of the lab director include supervision of laboratory, purchasing of equipment, and supervision of lab safety program. The Ana-Lab technical director will review and verify all laboratory data for integrity and continuity, reasonableness and conformance to project requirements, and then validate against the measurement performance specifications listed in this QAPP.

Tracy Varvel, Ana-Lab Quality Manager
Maintains quality assurance manual for laboratory operations, maintains operating procedures that are in compliance with this QAPP, amendments and appendices. Conducts in-house audits to ensure compliance with written SOPs, NELAP requirements and to identify potential problems. Responsible for the overall quality control and quality assurance of analyses performed by Ana-Lab laboratories. Reviews and verifies all laboratory data for integrity and continuity, reasonableness and conformance to project requirements, and then validates against the measurement performance specifications listed in this QAPP.

Figure A4.1 Project Organizational Chart* – Lines of Communication



* See Project/Task Organization in this section for a description of each position's responsibilities.
** Ana-Lab to be used to meet holding times in the event of equipment failure at the GBRA laboratory.

A5 PROBLEM DEFINITION/BACKGROUND

Plum Creek rises in Hays County north of Kyle and runs south through Caldwell County, passing Lockhart and Luling, and eventually joins the San Marcos River at their confluence north of Gonzales County. Plum Creek is 52 miles in length and has a drainage area of 389 mi^2. According to the *2008 TWQI and 303(d) List*, Plum Creek (Segment 1810) is impaired by elevated bacteria concentrations (category 5c) and exhibits nutrient enrichment concerns for ammonia, nitrate+nitrite nitrogen and total phosphorus. In the *2014 TWQI and 303d List*, TCEQ recognized the work being done in the Plum Creek watershed to reduce the pollutant loading and restore the water quality and changed the stream's category to 4b.

TSSWCB and Texas AgriLife Extension Service established the Plum Creek Watershed Partnership (PCWP) in April 2006. The PCWP Steering Committee completed the *Plum Creek WPP* in February 2008. Information about the PCWP is available at http://plumcreek.tamu.edu/. Sources of pollutants identified in the Plum Creek WPP include urban storm water runoff, pet waste, failing or inadequate on-site sewage facilities (septic systems), wastewater treatment facilities, livestock, wildlife, invasive species (feral hogs), and oil and gas production.

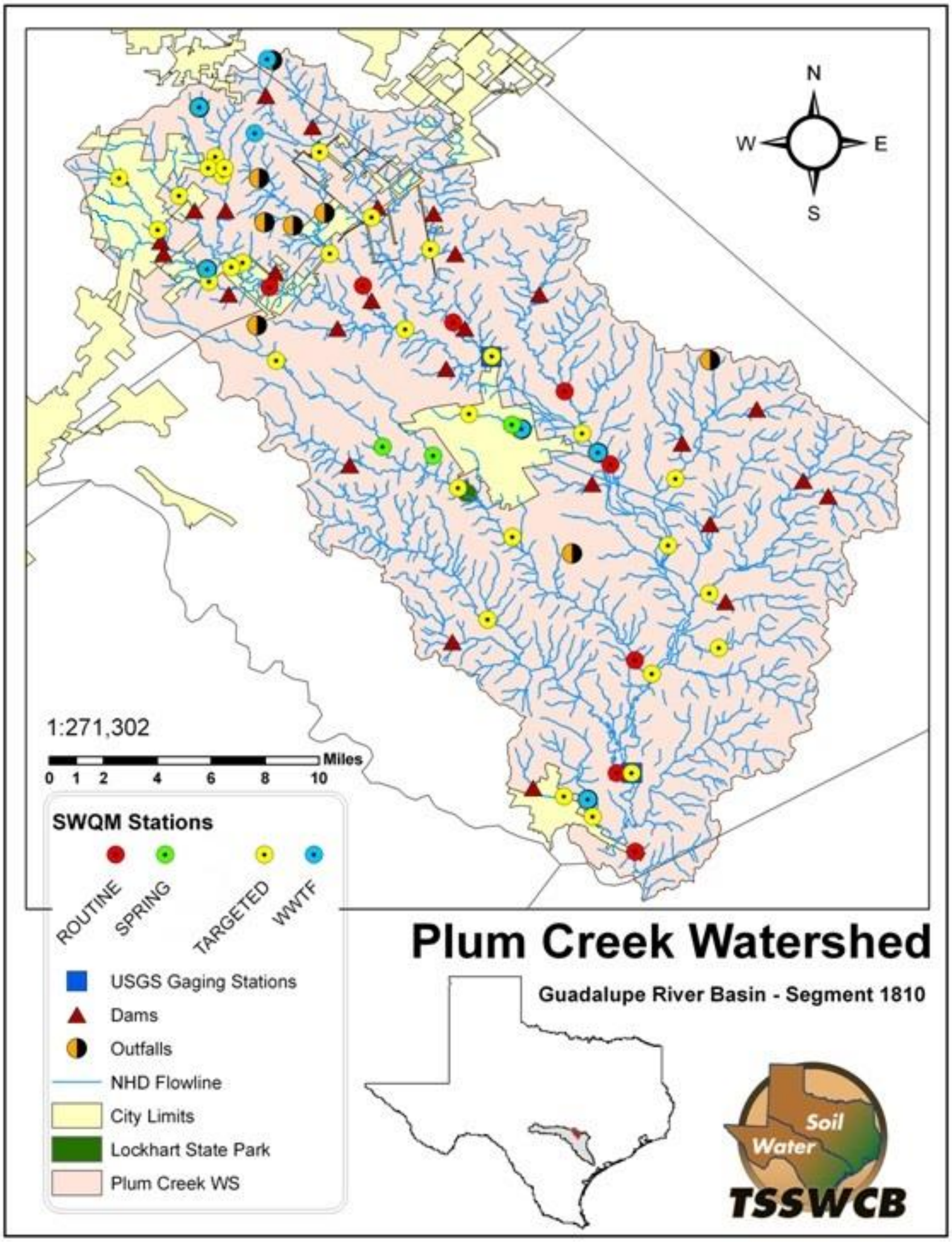
Through TSSWCB projects 03-19, 10-07, 14-11 and 17-09 GBRA collected water quality data to fill data gaps. During these projects, sampling of water quality data was severely hampered by drought that covered the watershed, causing the tributaries to run dry and the springs to slow to almost negligible flow.
Facilitated by the Plum Creek Watershed Coordinator, implementation of the Plum Creek WPP continues. TSSWCB provide technical assistance and financial incentives through the local soil and water conservation districts to agricultural producers in developing and implementing water quality management plans (WQMPs). In order to reduce feral hog impacts on the stream, education and technical assistance was provided by Texas AgriLife Extension Service to landowners in the watershed on strategies to reduce and manage feral hog populations. The cities of Kyle and Lockhart received TCEQ CWA §319(h) funding to retrofit detention facilities to improve water quality, educate and stencil storm sewer inlets, map existing storm water facilities, implement a dog waste collection station program, and coordinate city "housekeeping" activities designed to improve water quality (street sweeping, creek cleanup days, etc). Additionally, Lockhart evaluated their existing storm water system, identified and prioritized upgrades to the city's storm water management system, and coordinated creek cleanup days, and household hazardous and electronic waste collection days. An education and outreach campaign was initiated during the watershed planning process that focused on educating watershed residents and landowners on the impacts of specific land use activities, illegal dumping, proper operation and maintenance of OSSFs and proper disposal of pet waste.

The City of Kyle implemented a storm water management program that included improvements to storm water retention ponds. The City of Lockhart mapped the storm system. Using these maps, GBRA conducted illicit discharge detection monitoring on the city's storm system in 2015 and located several potential illicit discharge locations within the City of Lockhart. (*Plum Creek Watershed Protection Plan (WPP) Implementation – Illicit Discharge Monitoring* **(***TCEQ CWA Project No. 582-14-43865))*. Both cities have included public education and outreach in their programs. Monitoring sites downstream of these two cities will collect base flow as well as flows impacted by storm water.

To demonstrate improvements in water quality, the Plum Creek WPP describes a water quality monitoring program designed to evaluate the effectiveness of BMPs implemented across the watershed and their impacts on in-stream water quality. Water quality data will be used in the adaptive management of the WPP in order to evaluate progress in implementing the Plum Creek WPP and achieving water quality restoration. Sampling locations and frequencies (routine and targeted) are located so that the effectiveness of BMPs implemented in the watershed can be assessed. Data collected under previous projects (TSSWCB project 03-19, 10-54, 10-07, 14-11, 17-58, and 17-09) will be used as background for comparison of data collected after BMPs have been implemented. Additionally, monitoring sites have been located so that other BMPs that are recommended in the PC WPP, such as conversion of septic tanks to public wastewater system collection systems, feral hog control and water quality management plans on agricultural lands within the watershed, can be assessed for their impacts on in-stream water quality as well as their progress in achieving water quality restoration.

The purpose of this QAPP is to clearly delineate GBRA QA policy, management structure, and procedures, which are used to implement the QA requirements necessary to verify and validate the surface water quality data collected. Figure A5.1 is a map of the Plum Creek watershed.

Figure A5.1 Plum Creek Watershed and Sampling Locations



A6 PROJECT/TASK DESCRIPTION

Through this project, GBRA will collect SWQM data to characterize the Plum Creek watershed, including the contributing wastewater effluents. Monitoring data will be used to assess and evaluate the effectiveness of the BMPs that have been or will be implemented in the watershed as a result of the Plum Creek WPP. The sampling regime will include biological assessment, diurnal, spring flow and targeted monitoring under high flow and more typical base flow conditions over the next three years. This will provide a more complete and representative data set to characterize the Plum Creek watershed and document water quality improvements.

GBRA will conduct the work performed under this project including technical and financial supervision, preparation of status reports, coordination with local stakeholders, SWQM sample collection and analysis, and data management. GBRA will participate in the PCWP, Steering Committee, and Technical Advisory Group in order to communicate project goals, activities and accomplishments to affected parties.
Currently, routine ambient water quality data is collected monthly at 3 main stem stations by GBRA (17406, 12640 and 12647) through the Clean Rivers Program. Ammonia nitrogen and total kjeldahl nitrogen are currently monitored by the CRP at these 3 stations bimonthly. Through this project, GBRA will conduct routine ambient monitoring at an additional 4 sites monthly over 33 months, collecting field, conventional, stream flow and bacteria parameter groups. Conventional parameters for routine analysis will include total suspended solids, turbidity, sulfate, chloride, nitrate nitrogen, ammonia nitrogen, total kjelhdahl nitrogen, chlorophyll a, pheophytin, total hardness, and total phosphorus. Field parameters are temperature, pH, dissolved oxygen, and specific conductance. Flow parameters are stream flow, flow measurement method, and flow severity. Bacteria parameters are *E. coli*. The GBRA will also collect additional bimonthly ammonia nitrogen and total kjeldahl nitrogen at stations 17406, 12640 and 12647. This will complement the existing routine ambient monitoring regime conducted by GBRA such that the same routine water quality monitoring is conducted monthly at 7 sites in the Plum Creek watershed.

GBRA will conduct targeted watershed monitoring at 34 sites twice per quarter, once under dry weather conditions and once under wet weather conditions, collecting field, conventional, flow and bacteria parameter groups. Conventional parameters for targeted monitoring will be limited to total suspended solids, nitrate nitrogen, ammonia nitrogen, total kjeldahl nitrogen, and total phosphorus. Sampling period extends through 11 quarters. The 7 routine monitoring stations will only be resampled if targeted weather conditions have not been collected for the representative quarter during the course of routine sample collection. Spatial, seasonal and meteorological variation will be captured in these snapshots of watershed water quality.

GBRA will conduct 24-hour DO monitoring at 7 sites monthly during the months of the index period collecting field and flow parameter groups. These sites shall be the same as the sites for routine ambient monitoring. The index period of each year extends over 8 months (March through October), during each year of the project, except for year 3, in which the diurnal sampling will end at the end of the contract period. GBRA will continue to maintain the continuous monitoring site throughout the project.

GBRA will conduct effluent monitoring at seven wastewater treatment facilities (WWTFs) once per month collecting field, conventional, flow, bacteria and effluent parameter groups. The sampling period will extend over 33 months. This will characterize WWTF contributions to flow regime and pollutant loadings. Conventional parameters for wastewater effluents are total suspended solids, sulfate, chloride, nitrate nitrogen, ammonia nitrogen, total kjehldahl nitrogen, and total phosphorus. Effluent parameters are BOD, CBOD and COD.

GBRA will conduct spring flow monitoring at 3 springs once per quarter collecting field, conventional, flow and bacteria parameter groups. Conventional parameters for spring stations are total suspended solids, sulfate, chloride, nitrate nitrogen, ammonia nitrogen, total kjehldahl nitrogen and total phosphorus. The sampling period will extend over 11 quarters. Spatial and seasonal variation in spring flow will be captured. This will characterize spring contributions to flow regime and pollutant loadings.

Two aquatic life monitoring events will be performed at the Plum Creek at CR 135 (Station 12640), and Clear Fork of Plum Creek at Salt Flat Road (Station 12556) in order to gage the effects of WPP implementation efforts on the biological assemblages in the watershed. This monitoring will be accompanied by additional 24 hour dissolved oxygen, field and stream flow monitoring data. These aquatic life monitoring will be staggered so that only one station is monitored in a given calendar year.

GBRA maintains a real-time water quality monitoring station at the Plum Creek upstream of US 183 site (Station 18343) that collects field data every 15 minutes. In order to continue to raise awareness of water quality and stewardship in the Plum Creek watershed and make water quality data available to the public, GBRA will continue to maintain this station. A link to the public real-time monitoring site, is available on the GBRA website.

GBRA will post monitoring data to the GBRA website in a timely manner. GBRA will summarize the results and activities of this project through inclusion in GBRA's CRP Basin Highlights Report and/or Basin Summary Report. Additionally, the results and activities of this project will be summarized in quarterly reports to the stakeholders of the PCWP Steering Committee and in revisions to the Plum Creek WPP. GBRA will develop a final Assessment Data Report summarizing water quality data collected through Tasks 3.1-3.6 of the workplan. The Report shall, at a minimum, provide an assessment of water quality with respect to effectiveness of BMPs implemented and a discussion of interim short-term progress in achieving the Plum Creek WPP water quality goals.

See Appendix A for sampling design and monitoring pertaining to this QAPP.

Table A6.1 QAPP Milestones

TASK	PROJECT MILESTONES	AGENCY	START	END
2.1	Develop DQOs and QAPP for review by TSSWCB and USEPA.	GBRA	M1	M3
2.2	GBRA will implement the approved QAPP and will submit revisions to QAPP as necessary.	TSSWCB, GBRA	M1	M3
3.1	GBRA will monitor at 4 routine sites monthly, collecting field, conventional, flow and bacteria parameter groups and will collect TKN and Ammonia Nitrogen at 3 stations bimonthly in order to supplement existing routine monitoring in the basin.	GBRA	M4	M36
3.2	GBRA will conduct targeted monitoring at 34 sites, twice per quarter, once under dry conditions and once under wet conditions, collecting field, conventional, flow and bacteria parameter groups (Routine stations will not be resampled if similar targeted weather conditions have already been captured for the designated quarter).	GBRA	M4	M36
3.3	GBRA will conduct 24-hour DO monitoring at 7 sites monthly during the index period, collecting field and flow parameter groups.	GBRA	M4	M36
3.4	GBRA will conduct wastewater effluent monitoring at 7 WWTFs once per month, collecting field, conventional, flow, effluent and bacteria parameter groups.	GBRA	M4	M36
3.5	GBRA will conduct spring flow monitoring at 3 springs once per quarter, collecting field, conventional, flow and bacteria parameter groups.	GBRA	M4	M36
3.6	GBRA will perform multi-day aquatic life monitoring events on the Plum at CR 135 (Station 12640) and the Clear Fork of Plum Creek at CR 128 (Station 12556).	GBRA	M4	M36
3.7	GBRA will transfer monitoring data from activities in Tasks 3.1-3.6 to TCEQ Data Management and Analysis Team for inclusion in the TCEQ SWQMIS.	GBRA	M4	M36
3.8	GBRA will maintain a real-time water quality monitoring station on the Plum Creek upstream of US 183 (Station 18343) that collects continuous field data at 15-minute intervals.	GBRA	M4	M36
3.9	GBRA will develop a final assessment data report summarizing water quality data collected through task 3.6	GBRA	M4	M36

A7 QUALITY OBJECTIVES AND CRITERIA FOR DATA QUALITY

The purpose of routine water quality monitoring is to collect surface water data needed for water quality assessments in accordance with TCEQ's *Guidance for Assessing and Reporting Surface Water Quality in Texas*. These water quality data, and data collected by other organizations (e.g., USGS, TCEQ CRP, etc.), will be subsequently reconciled for use by the TSSWCB.

Systematic watershed monitoring, i.e., targeted monitoring, is defined by sampling that is planned for a short duration and is designed to: screen waters that would not normally be included in the routine monitoring program, monitor at sites to check the water quality situation, and investigate areas of potential concern. Targeted monitoring in the Plum Creek watershed, done under wet and dry conditions, will be collected to capture spatial, seasonal and meteorological snapshots of water quality. Targeted monitoring is designed to evaluate the effectiveness of BMPs (both rural and urban) across the watershed and measure their impacts on in-stream water quality.

GBRA will conduct diurnal water quality monitoring monthly during the index period. The diurnal monitoring will adhere to the specifications described in the TCEQ *SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue: RG-415 (August 2012 or most recent version)*. GBRA will also conduct effluent monitoring at 7 WWTFs to characterize the contributions to flow and pollutant loadings. Monitoring will be conducted on spring flow to characterize contributions to the flow and pollutant loadings. These water quality data will be subsequently reconciled for use and assessed by the TSSWCB. Biological Aquatic Life Monitoring (ALM) assessments of fish assemblage, benthic macroinvertebrate assemblage, and aquatic habitat will be conducted at two stations. ALM monitoring will adhere to the specifications described in the the TCEQ *SWQM Procedures, Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data: RG-416 (May 2014 or the most recent version)*.

The monitoring regime (routine, targeted, biological, 24-hour DO, effluent, and spring sampling) is designed to evaluate the effectiveness of BMPs (both rural and urban) across the watershed and measure their impacts on in-stream water quality. Water quality trends will be continually evaluated to document progress in implementing the WPP and progress in achieving restoration. This project is a part of a long-term monitoring program which will extend over the 10 year implementation schedule of the WPP.

The measurement performance specifications to support the project objectives for a minimum data set are specified in Table A7and in the text following.

Table A7.1 GBRA Measurement Performance Specifications

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Field Parameters										
pH	pH/ units	water	SM 4500-H^+ B. & TCEQ SOP, V1	00400	NA[1]	NA	NA	NA	NA	Field
DO	mg/L	water	SM 4500-O G. & TCEQ SOP, V1	00300	NA[1]	NA	NA	NA	NA	Field
Conductivity	umhos/cm	water	SM 2510 & TCEQ SOP, V1	00094	NA[1]	NA	NA	NA	NA	Field
Temperature	ºC	water	SM 2550 & TCEQ SOP, V1	00010	NA[1]	NA	NA	NA	NA	Field
Flow	cfs	water	TCEQ SOP, V1	00061	NA[1]	NA	NA	NA	NA	Field
% pool coverage in 500 meter reach	%	water	TCEQ SOP, V2	89870	NA[1]	NA	NA	NA	NA	Field
Depth of bottom of water body at sample site	m	water	TCEQ SOP, V2	82903	NA[1]	NA	NA	NA	NA	Field
Maximum pool width at time of study	m	water	TCEQ SOP, V2	89864	NA[1]	NA	NA	NA	NA	Field
Maximum pool depth at time of study	m	water	TCEQ SOP, V2	89865	NA[1]	NA	NA	NA	NA	Field
Pool length	m	water	TCEQ SOP, V2	89869	NA[1]	NA	NA	NA	NA	Field
Days since precipitation event	days	other	TCEQ SOP, V1	72053	NA[1]	NA	NA	NA	NA	Field
Flow measurement method	1-gage 2-electric 3-mechanical 4-weir/flume 5-doppler	water	TCEQ SOP, V1	89835	NA[1]	NA	NA	NA	NA	Field
Flow severity	1-no flow 2-low 3-normal 4-flood 5-high 6-dry	water	TCEQ SOP, V1	01351	NA[1]	NA	NA	NA	NA	Field
Flow Estimate	cfs	water	TCEQ SOP, V1	74069	NA[1]	NA	NA	NA	NA	Field
Conventional and Bacteriological Parameters										
Residue, Total Nonfiltrable (TSS)	mg/L	water	SM 2540D	00530	5	1[3]	NA	NA	NA	GBRA[4]
Turbidity	NTU	water	SM 2130B[9]	82079	0.5	0.5	NA	NA	NA	GBRA[4]
Sulfate	mg/L	water	EPA 300.0 Rev. 2.1 (1993)	00945	5	1	70-130	20	80-120	GBRA[4]
Chloride	mg/L	water	EPA 300.0 Rev. 2.1 (1993)	00940	5	1	70-130	20	80-120	GBRA[4]
Chlorophyll-a, spectro-photometric method	ug/L	water	SM 10200-H[7]	32211	3	1[5]	NA	20	NA	GBRA[4]

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Pheophytin, spectro-photometric method	ug/L	water	SM 10200-H[7]	32218	3	1[5]	NA	NA	NA	GBRA[4]
E. coli, IDEXX™ Colilert[6]	MPN/100 mL	water	Colilert - 18	31699	1	1	NA	0.5[2]	NA	GBRA[4]
E. coli, IDEXX™ Colilert[6]	Hours	water	Colilert - 18	31704	NA	NA	NA	NA	NA	GBRA
Ammonia-N, total	mg/L	water	EPA 350.1 Rev. 2.0 (1993)	00610	0.1	0.1	70-130	20	80-120	GBRA[4]
Hardness, total (as $CaCO_3$)	mg/L	water	SM 2340 C	00900	5	5	NA	20	80-120	GBRA[4]
Nitrate-N, total	mg/L	water	EPA 300.0 Rev. 2.1 (1993)	00620	0.05	0.05	70-130	20	80-120	GBRA[4]
Total phosphorus	mg/L	water	EPA 365.3	00665	0.06	0.02	70-130	20	80-120	GBRA[4]
Total Kjeldahl Nitrogen	mg/L	water	EPA 351.2 Rev. 2 (1993)	00625	0.2	0.2	70-130	20	80-120	GBRA[4]
BOD, 5-day	mg/L	water	SM 5210B	00310	2	1.0	NA	<10 = 33.3 >10 = 15.4	NA	GBRA[4]
CBOD, 5-day	mg/L	water	SM 5210B	80082	2	1.0	NA	<10 = 33.3 >10 = 15.4	NA	GBRA[4]
COD	mg/L	water	SM 5220D	00335	10	20.0	70-130	20	80-120	Ana-Lab[8]
Diurnal monitoring summary statistics										
24-hour average DO	mg/L	water	TCEQ SOP, V1	89857	NA	NA	NA	NA	NA	GBRA
Maximum daily DO	mg/L	water	TCEQ SOP, V1	89856	NA	NA	NA	NA	NA	GBRA
Minimum daily DO	mg/L	water	TCEQ SOP, V1	89855	NA	NA	NA	NA	NA	GBRA
Number of DO measurements	none	none	TCEQ SOP, V1	89858	NA	NA	NA	NA	NA	GBRA
Number of temperature measurements	none	none	TCEQ SOP, V1	00221	NA	NA	NA	NA	NA	GBRA
Number of conductivity measurements	none	none	TCEQ SOP, V1	00222	NA	NA	NA	NA	NA	GBRA
Number of pH measurements	none	none	TCEQ SOP, V1	00223	NA	NA	NA	NA	NA	GBRA
24-hour average water temperature	ºC	water	TCEQ SOP, V1	00209	NA	NA	NA	NA	NA	GBRA
Maximum daily water temperature	ºC	water	TCEQ SOP, V1	00210	NA	NA	NA	NA	NA	GBRA
Minimum daily water temperature	ºC	water	TCEQ SOP, V1	00211	NA	NA	NA	NA	NA	GBRA
24-hour average conductivity	umhos/cm	water	TCEQ SOP, V1	00212	NA	NA	NA	NA	NA	GBRA
Maximum daily conductivity	umhos/cm	water	TCEQ SOP, V1	00213	NA	NA	NA	NA	NA	GBRA

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Minimum daily conductivity	umhos/cm	water	TCEQ SOP, V1	00214	NA	NA	NA	NA	NA	GBRA
Maximum daily pH	s.u.	water	TCEQ SOP, V1	00215	NA	NA	NA	NA	NA	GBRA
Minimum daily pH	s.u.	water	TCEQ SOP, V1	00216	NA	NA	NA	NA	NA	GBRA
Biological - Habitat										
FLOW STREAM, INSTANTANEOUS (CUBIC FEET PER SEC)	cfs	Water	TCEQ SOP V2	00061	NA	NA	NA	NA	NA	GBRA
BIOLOGICAL DATA	NS	Other	NA/Calculation	89888	NA	NA	NA	NA	NA	GBRA
STREAM TYPE; 1=PERENNIAL 2=INTERMITTENT S/PERENNIAL POOLS 3=INTERMITTENT 4=UNKNOWN	NU	Water	NA/Calculation	89821	NA	NA	NA	NA	NA	GBRA
STREAMBED SLOPE (M/KM)	M/KM	Other	NA/Calculation	72051	NA	NA	NA	NA	NA	GBRA
AVERAGE PERCENTAGE INSTREAM COVER	%	Other	TCEQ SOP V2	84159	NA	NA	NA	NA	NA	GBRA
STREAM ORDER	NU	Water	TCEQ SOP V2	84161	NA	NA	NA	NA	NA	GBRA
NUMBER OF LATERAL TRANSECTS MADE	NU	Other	TCEQ SOP V2	89832	NA	NA	NA	NA	NA	GBRA
FLOW MTH 1=GAGE 2=ELEC 3=MECH 4=WEIR/FLU 5=DOPPLER	NU	Other	TCEQ SOP V2	89835	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF STREAM BENDS	NU	Other	TCEQ SOP V2	89839	NA	NA	NA	NA	NA	GBRA
NUMBER OF WELL DEFINED STREAM BENDS	NU	Other	TCEQ SOP V2	89840	NA	NA	NA	NA	NA	GBRA
NUMBER OF MODERATELY DEFINED STREAM BENDS	NU	Other	TCEQ SOP V2	89841	NA	NA	NA	NA	NA	GBRA

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
NUMBER OF POORLY DEFINED STREAM BENDS	NU	Other	TCEQ SOP V2	89842	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF RIFFLES	NU	Other	TCEQ SOP V2	89843	NA	NA	NA	NA	NA	GBRA
DOMINANT SUBSTRATE TYPE(1=CLAY, 2=SILT,3=SAND,4=GRAVEL,5=COBBLE,6=BOULDER,7=BEDROCK,8=OTHER)	NU	Sediment	TCEQ SOP V2	89844	NA	NA	NA	NA	NA	GBRA
AVERAGE PERCENT OF SUBSTRATE GRAVEL SIZE OR LARGER	%	Other	TCEQ SOP V2	89845	NA	NA	NA	NA	NA	GBRA
AVERAGE STREAM BANK EROSION (%)	%	Other	TCEQ SOP V2	89846	NA	NA	NA	NA	NA	GBRA
AVERAGE STREAM BANK SLOPE (DEGREES)	deg	Other	TCEQ SOP V2	89847	NA	NA	NA	NA	NA	GBRA
HABITAT FLOW STATUS, 1=NO FLOW, 2=LOW,3=MOD,4=HIGH	NU	Other	TCEQ SOP V2	89848	NA	NA	NA	NA	NA	GBRA
AVERAGE PERCENT TREES AS RIPARIAN VEGETATION	%	Other	TCEQ SOP V2	89849	NA	NA	NA	NA	NA	GBRA
AVERAGE PERCENT SHRUBS AS RIPARIAN VEGETATION	%	Other	TCEQ SOP V2	89850	NA	NA	NA	NA	NA	GBRA
AVERAGE PERCENT GRASS AS RIPARIAN VEGETATION	%	Other	TCEQ SOP V2	89851	NA	NA	NA	NA	NA	GBRA
AVERAGE PERCENT CULTIVATED FIELDS AS RIPARIAN VEGETATION	%	Other	TCEQ SOP V2	89852	NA	NA	NA	NA	NA	GBRA

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
AVERAGE PERCENT OTHER AS RIPARIAN VEGETATION	%	Other	TCEQ SOP V2	89853	NA	NA	NA	NA	NA	GBRA
AVERAGE PERCENTAGE OF TREE CANOPY COVERAGE	%	Other	TCEQ SOP V2	89854	NA	NA	NA	NA	NA	GBRA
DRAINAGE AREA ABOVE MOST DOWNSTREAM TRANSECT*	km2	Other	TCEQ SOP V2	89859	NA	NA	NA	NA	NA	GBRA
REACH LENGTH OF STREAM EVALUATED (M)	m	Other	NA/Calculation	89884	NA	NA	NA	NA	NA	GBRA
AVERAGE STREAM WIDTH (METERS)	M	Other	TCEQ SOP V2	89861	NA	NA	NA	NA	NA	GBRA
AVERAGE STREAM DEPTH (METERS)	M	Other	TCEQ SOP V2	89862	NA	NA	NA	NA	NA	GBRA
MAXIMUM POOL WIDTH AT TIME OF STUDY (METERS)	M	Other	TCEQ SOP V2	89864	NA	NA	NA	NA	NA	GBRA
MAXIMUM POOL DEPTH AT TIME OF STUDY(METERS)	M	Other	TCEQ SOP V2	89865	NA	NA	NA	NA	NA	GBRA
AVERAGE WIDTH OF NATURAL RIPARIAN VEGETATION (M)	M	Other	TCEQ SOP V2	89866	NA	NA	NA	NA	NA	GBRA
AVERAGE WIDTH OF NATURAL RIPARIAN BUFFER ON LEFT BANK (M)	M	Other	NA/Calculation	89872	NA	NA	NA	NA	NA	GBRA
AVERAGE WIDTH OF NATURAL RIPARIAN BUFFER ON RIGHT BANK (M)	m	Other	NA/Calculation	89873	NA	NA	NA	NA	NA	GBRA

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
AESTHETICS OF REACH(1=WILD 2=NAT. 3=COMM. 4=OFF.)	NU	Other	TCEQ SOP V2	89867	NA	NA	NA	NA	NA	GBRA
NUMBER OF STREAM COVER TYPES	NU	Other	TCEQ SOP V2	89929	NA	NA	NA	NA	NA	GBRA
LAND DEVELOP IMPACT (1=UNIMP,2=LOW,3=MOD,4=HIGH)	NU	Other	TCEQ SOP V2	89962	NA	NA	NA	NA	NA	GBRA
RIPARIAN VEGETATION %; LEFT BANK - TREES	%	Other	NA/Calculation	89822	NA	NA	NA	NA	NA	GBRA
RIPARIAN VEGETATION %; RIGHT BANK - TREES	%	Other	NA/Calculation	89823	NA	NA	NA	NA	NA	GBRA
RIPARIAN VEGETATION %; LEFT BANK SHRUBS	%	Other	NA/Calculation	89824	NA	NA	NA	NA	NA	GBRA
RIPARIAN VEGETATION %; RIGHT BANK - SHRUBS	%	Other	NA/Calculation	89825	NA	NA	NA	NA	NA	GBRA
RIPARIAN VEGETATION %: LEFT BANK - GRASSES OR FORBS	%	Other	NA/Calculation	89826	NA	NA	NA	NA	NA	GBRA
RIPARIAN VEGETATION %; RIGHT BANK - GRASSES OR FORBS	%	Other	NA/Calculation	89827	NA	NA	NA	NA	NA	GBRA
RIPARIAN VEGETATION %: LEFT BANK - CULTIVATED FIELDS	%	Other	NA/Calculation	89828	NA	NA	NA	NA	NA	GBRA
RIPARIAN VEGETATION %: RIGHT BANK - CULTIVATED FIELDS	%	Other	NA/Calculation	89829	NA	NA	NA	NA	NA	GBRA

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
RIPARIAN VEGETATION %: LEFT BANK - OTHER	%	Other	NA/Calculation	89830	NA	NA	NA	NA	NA	GBRA
RIPARIAN VEGETATION %: RIGHT BANK - OTHER	%	Other	NA/Calculation	89871	NA	NA	NA	NA	NA	GBRA
AVAILABLE INSTREAM COVER HQI SCORE: 4=ABUNDANT 3=COMMON 2=RARE 1=ABSENT	NU	Other	NA/Calculation	89874	NA	NA	NA	NA	NA	GBRA
BOTTOM SUBSTRATE STABILITY HQI SCORE: 4=STABLE 3=MODERATE LY STABLE 2=MODERATE LY UNSTABLE 1=UNSTABLE	NU	Other	NA/Calculation	89875	NA	NA	NA	NA	NA	GBRA
NUMBER OF RIFFLES HQI SCORE: 4=ABUNDANT 3=COMMON 2=RARE 1=ABSENT	NS	Other	NA/Calculation	89876	NA	NA	NA	NA	NA	GBRA
DIMENSIONS OF LARGEST POOL HQI SCORE: 4=LARGE 3=MODERATE 2=SMALL 1=ABSENT	NU	Other	NA/Calculation	89877	NA	NA	NA	NA	NA	GBRA
CHANNEL FLOW STATUS HQI SCORE: 3=HIGH 2=MODERATE 1=LOW 0=NO FLOW	NU	Other	NA/Calculation	89878	NA	NA	NA	NA	NA	GBRA
BANK STABILITY HQI SCORE: 3=STABLE 2=MODERATE LY STABLE 1=MODERATE LY UNSTABLE 0=UNSTABLE	NU	Other	NA/Calculation	89879	NA	NA	NA	NA	NA	GBRA

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
CHANNEL SINUOSITY HQI SCORE: 3=HIGH 2=MODERATE 1=LOW 0=NONE	NU	Other	NA/Calculation	89880	NA	NA	NA	NA	NA	GBRA
RIPARIAN BUFFER VEGETATION HQI SCORE: 3=EXTENSIVE 2=WIDE 1=MODERATE 0=NARROW	NU	Other	NA/Calculation	89881	NA	NA	NA	NA	NA	GBRA
AESTHETICS OF REACH HQI SCORE: 3=WILDERNESS 2=NATURAL AREA 1=COMMON SETTING 0=OFFENSIVE	NU	Other	NA/Calculation	89882	NA	NA	NA	NA	NA	GBRA
HQI TOTAL SCORE	NU	Other	NA/Calculation	89883	NA	NA	NA	NA	NA	GBRA
LENGTH OF STREAM EVALUATED (KM)	KM	Other	NA/Calculation	89860	NA	NA	NA	NA	NA	GBRA
STREAMBED SLOPE (FT/FT)	FT/FT	Other	NA/Calculation	72052	NA	NA	NA	NA	NA	GBRA
NO FLOW ISOLATED POOL: LARGEST POOL MAX WIDTH (M	M	Other	NA/Calculation	89908	NA	NA	NA	NA	NA	GBRA
NO FLOW ISOLATED POOL: LARGEST POOL MAX LENGTH (	M	Other	NA/Calculation	89909	NA	NA	NA	NA	NA	GBRA
NO FLOW ISOLATED POOL: LARGEST POOL MAX DEPTH (M	M	Other	NA/Calculation	89910	NA	NA	NA	NA	NA	GBRA
NO FLOW ISOLATED POOL: SMALLEST POOL MAX DEPTH (	M	Other	NA/Calculation	89911	NA	NA	NA	NA	NA	GBRA

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
NO FLOW ISOLATED POOL: SMALLEST POOL MAX WIDTH (	M	Other	NA/Calculation	89912	NA	NA	NA	NA	NA	GBRA
NO FLOW ISOLATED POOL: SMALLEST POOL MAX LENGTH	M	Other	NA/Calculation	89913	NA	NA	NA	NA	NA	GBRA
NO FLOW ISOLATED POOLS: NUMBER OF POOLS EVALUATED	NU	Other	NA/Calculation	89914	NA	NA	NA	NA	NA	GBRA
Biological – Benthics										
STREAM ORDER	NU	Water	TCEQ SOP, V1	84161	NA	NA	NA	NA	NA	GBRA
BIOLOGICAL DATA	NS	Other	NA/Calculation	89888	NA	NA	NA	NA	NA	GBRA
RAPID BIOASSESSMENT PROTOCOLS BENTHIC MACROINVERTEBRATE IBI SCORE	NS	Other	NA/Calculation	90081	NA	NA	NA	NA	NA	GBRA
BENTHIC DATA REPORTING UNITS (1=NUMBER OF INDIVIDUALS IN SUB-SAMPLE, 2=NUMBER OF INDIVIDUALS/ FT2, 3=NUMBER OF INDIVIDUALS/ M2, 4=TOTAL NUMBER OF INDIVIDUALS IN SAMPLE)	NU	Other	TCEQ SOP V2	89899	NA	NA	NA	NA	NA	GBRA
DIP NET EFFORT,AREA SWEPT (SQ.METER)	m2	Other	TCEQ SOP V2	89902	NA	NA	NA	NA	NA	GBRA
KICKNET EFFORT,AREA KICKED (SQ.METER)	m2	Other	TCEQ SOP V2	89903	NA	NA	NA	NA	NA	GBRA

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
KICKNET EFFORT,MINUTES KICKED (MIN.)	min.	Other	TCEQ SOP V2	89904	NA	NA	NA	NA	NA	GBRA
DEBRIS/SHORELINE SAMPLING EFFORT, MINUTES	min.	Other	TCEQ SOP V2	89905	NA	NA	NA	NA	NA	GBRA
NUMBER OF INDIVIDUALS IN BENTHIC SAMPLE	NU	Other	TCEQ SOP V2	89906	NA	NA	NA	NA	NA	GBRA
UNDERCUT BANK AT COLLECTION POINT (%)	%	Other	TCEQ SOP V2	89921	NA	NA	NA	NA	NA	GBRA
OVERHANGING BRUSH AT COLLECTION POINT (%)	%	Other	TCEQ SOP V2	89922	NA	NA	NA	NA	NA	GBRA
GRAVEL BOTTOM AT COLLECTION POINT (%)	%	Sediment	TCEQ SOP V2	89923	NA	NA	NA	NA	NA	GBRA
SAND BOTTOM AT COLLECTION POINT (%)	%	Sediment	TCEQ SOP V2	89924	NA	NA	NA	NA	NA	GBRA
SOFT BOTTOM AT COLLECTION POINT (%)	%	Sediment	TCEQ SOP V2	89925	NA	NA	NA	NA	NA	GBRA
MACROPHYTE BED AT COLLECTION POINT (%)	%	Other	TCEQ SOP V2	89926	NA	NA	NA	NA	NA	GBRA
SNAGS AND BRUSH AT COLLECTION POINT (%)	%	Other	TCEQ SOP V2	89927	NA	NA	NA	NA	NA	GBRA
BEDROCK STREAMBED AT COLLECTION POINT (%)	%	Sediment	TCEQ SOP V2	89928	NA	NA	NA	NA	NA	GBRA
PETERSEN SAMPLER EFFORT, AREA SAMPLED (SQ. MTR.)	m2	Other	TCEQ SOP V2	89934	NA	NA	NA	NA	NA	GBRA
EKMAN SAMPLER EFFORT, AREA SAMPLED (SQ.METER)	m2	Other	TCEQ SOP V2	89935	NA	NA	NA	NA	NA	GBRA

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MESH SIZE, ANY NET OR SIEVE, AVERAGE BAR (CM)	cm	Other	TCEQ SOP V2	89946	NA	NA	NA	NA	NA	GBRA
BENTHIC SAMPLE COLLECTION METHOD (1=SURBER, 2=EKMAN, 3=KICKNET, 4=PETERSON, 5=HESTER DENDY, 6=SNAG, 7=HESS)	NU	Other	TCEQ SOP V2	89950	NA	NA	NA	NA	NA	GBRA
ECOREGION LEVEL III (TEXAS ECOREGION CODE)	NU	Other	TCEQ SOP V1	89961	NA	NA	NA	NA	NA	GBRA
BENTHOS ORGANISMS - NONE PRESENT (0=NONE PRESENT)	NS	Other	TCEQ SOP V2	90005	NA	NA	NA	NA	NA	GBRA
HILSENHOFF BIOTIC INDEX (HBI)	NU	Other	TCEQ SOP V2	90007	NA	NA	NA	NA	NA	GBRA
NUMBER OF EPT INDEX	NU	Other	TCEQ SOP V2	90008	NA	NA	NA	NA	NA	GBRA
DOMINANT BENTHIC FUNCTIONAL FEEDING GRP, % OF INDIVIDUALS	%	Other	TCEQ SOP V2	90010	NA	NA	NA	NA	NA	GBRA
BENTHIC GATHERERS, PERCENT OF INDIVIDUALS	%	Other	TCEQ SOP V2	90025	NA	NA	NA	NA	NA	GBRA
BENTHIC PREDATORS, PERCENT OF INDIVIDUALS	%	Other	TCEQ SOP V2	90036	NA	NA	NA	NA	NA	GBRA
DOMINANT TAXON, BENTHOS PERCENT OF INDIVIDUALS	%	Other	TCEQ SOP V2	90042	NA	NA	NA	NA	NA	GBRA
RATIO OF INTOLERANT TO TOLERANT TAXA, BENTHOS	NU	Other	TCEQ SOP V2	90050	NA	NA	NA	NA	NA	GBRA

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NUMBER OF NON-INSECT TAXA	NU	Other	TCEQ SOP V2	90052	NA	NA	NA	NA	NA	GBRA
ELMIDAE, PERCENT OF INDIVIDUALS	%	Other	TCEQ SOP V2	90054	NA	NA	NA	NA	NA	GBRA
TOTAL TAXA RICHNESS, BENTHOS	NU	Other	TCEQ SOP V2	90055	NA	NA	NA	NA	NA	GBRA
CHIRONOMIDAE, PERCENT OF INDIVIDUALS	%	Other	TCEQ SOP V2	90062	NA	NA	NA	NA	NA	GBRA
PERCENT OF TOTAL TRICHOPTERA INDIVIDUALS AS HYDROPSYCHIDAE	%	Other	TCEQ SOP V2	90069	NA	NA	NA	NA	NA	GBRA
TOTAL # OF BENTHIC GENERA IN SAMPLE	NU	Other	TCEQ SOP V3	90011	NA	NA	NA	NA	NA	GBRA
BENTHIC SHREDDERS (% OF COMMUNITY)	%	Other	TCEQ SOP V2	90035	NA	NA	NA	NA	NA	GBRA
TOTAL # OF FAMILIES IN BENTHIC SAMPLE	NU	Other	TCEQ SOP V2	90012	NA	NA	NA	NA	NA	GBRA
HESS SAMPLER EFFORT, AREA SAMPLED (SQ. METER)	m2	Other	TCEQ SOP V2	89956	NA	NA	NA	NA	NA	GBRA
Biological – Nekton										
STREAM ORDER	NU	Water	TCEQ SOP V1	84161	NA	NA	NA	NA	NA	GBRA
NEKTON TEXAS REGIONAL IBI SCORE	NS	Other	NA/Calculation	98123	NA	NA	NA	NA	NA	GBRA
BIOLOGICAL DATA	NS	Other	NA/Calculation	89888	NA	NA	NA	NA	NA	GBRA
SEINE, MINIMUM MESH SIZE, AVERAGE BAR, NEKTON,IN	IN	Other	TCEQ SOP V2	89930	NA	NA	NA	NA	NA	GBRA
SEINE, MAXIMUM MESH SIZE, AVG BAR, NEKTON,INCH	IN	Other	TCEQ SOP V2	89931	NA	NA	NA	NA	NA	GBRA

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NET LENGTH (METERS)	M	Other	TCEQ SOP V2	89941	NA	NA	NA	NA	NA	GBRA
ELECTROFISHING METHOD 1=BOAT 2=BACKPACK 3=TOTEBARGE	NU	Other	TCEQ SOP V2	89943	NA	NA	NA	NA	NA	GBRA
ELECTROFISH EFFORT, DURATION OF SHOCKING (SEC)	SEC	Other	TCEQ SOP V2	89944	NA	NA	NA	NA	NA	GBRA
SEINING EFFORT (# OF SEINE HAULS)	NU	Other	TCEQ SOP V2	89947	NA	NA	NA	NA	NA	GBRA
COMBINED LENGTH OF SEINE HAULS (METERS)	M	Other	TCEQ SOP V2	89948	NA	NA	NA	NA	NA	GBRA
SEINING EFFORT, DURATION (MINUTES)	MIN	Other	TCEQ SOP V2	89949	NA	NA	NA	NA	NA	GBRA
ECOREGION LEVEL III (TEXAS ECOREGION CODE)	NU	Other	TCEQ SOP V1	89961	NA	NA	NA	NA	NA	GBRA
AREA SEINED (SQ METERS)	M2	Other	TCEQ SOP V2	89976	NA	NA	NA	NA	NA	GBRA
NUMBER OF SPECIES, FISH	NU	Other	TCEQ SOP V2	98003	NA	NA	NA	NA	NA	GBRA
NEKTON ORGANISMS-NONE PRESENT (0=NONE PRESENT)	NS	Other	TCEQ SOP V2	98005	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF SUNFISH SPECIES	NU	Other	TCEQ SOP V2	98008	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF INTOLERANT SPECIES, FISH	NU	Other	TCEQ SOP V2	98010	NA	NA	NA	NA	NA	GBRA
PERCENT OF INDIVIDUALS AS OMNIVORES, FISH	%	Other	TCEQ SOP V2	98017	NA	NA	NA	NA	NA	GBRA
PERCENT OF INDIVIDUALS AS INVERTIVORES, FISH	%	Other	TCEQ SOP V2	98021	NA	NA	NA	NA	NA	GBRA

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
PERCENT OF INDIVIDUALS AS PISCIVORES, FISH	%	Other	TCEQ SOP V2	98022	NA	NA	NA	NA	NA	GBRA
PERCENT OF INDIVIDUALS WITH DISEASE OR ANOMALY	%	Other	TCEQ SOP V2	98030	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF NATIVE CYPRINID SPECIES	NU	Other	TCEQ SOP V2	98032	NA	NA	NA	NA	NA	GBRA
PERCENT INDIVIDUALS AS NON-NATIVE FISH SPECIES (% OF COMMUNITY)	%	Other	TCEQ SOP V2	98033	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF INDIVIDUALS SEINING	NU	Other	TCEQ SOP V2	98039	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF INDIVIDUALS ELECTROFISHING	NU	Other	TCEQ SOP V2	98040	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF BENTHIC INVERTIVORE SPECIES	NU	Other	TCEQ SOP V2	98052	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF BENTHIC FISH SPECIES	NU	Other	TCEQ SOP V2	98053	NA	NA	NA	NA	NA	GBRA
NUMBER OF INDIVIDUALS PER SEINE HAUL	NU	Other	TCEQ SOP V2	98062	NA	NA	NA	NA	NA	GBRA
NUMBER OF INDIVIDUALS PER MINUTE ELECTROFISHING	NU	Other	TCEQ SOP V2	98069	NA	NA	NA	NA	NA	GBRA
PERCENT INDIVIDUALS AS TOLERANT FISH SPECIES (EXCLUDING WESTERN MOSQUITOFISH)	%	Other	TCEQ SOP V2	98070	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF SUCKER SPECIES	NU	Other	TCEQ SOP V2	98009	NA	NA	NA	NA	NA	GBRA

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
PERCENT OF INDIVIDUALS AS HYBRIDS	%	Other	TCEQ SOP V2	98024	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF INDIVIDUALS IN SAMPLE, FISH	NU	Other	TCEQ SOP V2	98023	NA	NA	NA	NA	NA	GBRA
PERCENT OF INDIVIDUALS AS TOLERANTS, FISH	%	Other	TCEQ SOP V2	98016	NA	NA	NA	NA	NA	GBRA
TOTAL NUMBER OF DARTER SPECIES	NU	Other	TCEQ SOP V2	98004	NA	NA	NA	NA	NA	GBRA

1 Reporting to be consistent with TCEQ SWQM guidance and based on measurement capability.
2 Based on range statistic as described in Standard Methods, 20th Edition, Section 9020-B, "Quality Assurance / Quality Control – Intralaboratory Quality Control Guidelines." This criterion applies to bacteriological duplicates with concentrations greater than 10 MPN/100 mL or greater than 10 organisms/100 mL.
3 TSS LOQ is based on the volume of sample used.
4 Ana-Lab may be used in the event of lab equipment failure so that samples will be processed within prescribed holding times. In the case of *E. coli*. Ana-Lab LOQ may be different from GBRA LOQ.
5 Reporting limit. Not a NELAP-defined LOQ (no commercially available spiking solution used as LOQ check standard.)
6 E.coli samples analyzed by Colilert-18 or SM 9223-B should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 24 hours. Actual holding time will be reported under STORET # 31704 only for those samples that exceed the 8 hour holding time.
7 Ana-Lab uses EPA Method 445 for the analysis of Chlorophyll A and Pheophytin.
8 The Ana-Lab laboratory will be the primary laboratory used for analysis of COD.

References for Table A7:

United States Environmental Protection Agency (USEPA) "Methods for Chemical Analysis of Water and Wastes," Manual #EPA-600/4-79-020

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), "Standard Methods for the Examination of Water and Wastewater," 23rd Edition, 2017

TCEQ SOP V1 - TCEQ SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, August 2012 or subsequent editions (RG-415)

TCEQ SOP V2 - TCEQ SWQM Procedures, Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data, May 2014 or subsequent editions (RG-416)

Ambient Water Reporting Limits (AWRLs)

The AWRL establishes the reporting specification at or below which data for a parameter must be reported to be compared with freshwater screening criteria. The AWRLs specified in Table A7 are the program-defined reporting specifications for each analyte and yield data acceptable for TCEQ water quality assessment. The LOQ (formerly known as reporting limit) is the minimum level, concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. The following requirements must be met in order to report results to the TSSWCB:

- The laboratory's LOQ for each analyte must be at or below the AWRL as a matter of routine practice
- The laboratory must demonstrate its ability to quantitate at its LOQ for each analyte by running an LOQ check standard for each batch of samples analyzed.
- Control limits for LOQ check samples are found in Table A7.

Laboratory Measurement QC Requirements and Acceptability Criteria are provided in Section B5.

Precision

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. It is a measure of agreement among replicate measurements of the same property, under prescribed similar conditions, and is an indication of random error.

Laboratory precision is assessed by comparing replicate analyses of laboratory control samples in the sample matrix (e.g. deionized water, sand, commercially available tissue) or sample/duplicate pairs in the case of bacterial analysis. Precision results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Table A7.

Bias

Bias is a statistical measurement of correctness and includes multiple components of systematic error. A measurement is considered unbiased when the value reported does not differ from the true value. Bias is determined through the analysis of laboratory control samples and LOQ check standards prepared with verified and known amounts of all target analytes in the sample matrix (e.g. deionized water) and by calculating percent recovery. Results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for LCSs are specified in Table A7.

Representativeness

Site selection, the appropriate sampling regime, the sampling of all pertinent media according to TCEQ SWQM SOPs, and use of only approved analytical methods will assure that the measurement data represents the conditions at the monitoring sites. Routine data collected for this project and submitted to TSSWCB for water quality assessments, are considered to be spatially and temporally representative of routine water quality conditions. Water quality data are collected on a routine frequency and are separated by approximately even time intervals. At a minimum, samples are collected over 11 quarters (to include inter-seasonal variation) and in the case of diurnal sampling, monthly during an index period (March - October). Although data may be collected during varying regimes of weather and flow, the data sets collected during routine monitoring will not be biased toward unusual conditions of flow, runoff, or season. The goal for meeting total representation of the water body will be tempered by the availability of stream and meteorological conditions during the project and the potential funding for complete representativeness.

Data collection for targeted sampling will be toward both ambient conditions and those conditions that are influenced by storm events. Spring flow will be collected spatially, seasonally and under varying meteorological conditions. Sampling of wastewater treatment facilities will be conducted once per month, without regard to specific meteorological conditions or facility flow regimes. Representativeness will be measured with the completion of sample collection in accordance with the approved QAPP.

Comparability

Confidence in the comparability of routine data sets for this project and for water quality assessments is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP and in TCEQ SWQM SOPs. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in a standard format as specified in Section B10.

Completeness

The completeness of the data is basically a relationship of how much of the data is available for use compared to the total potential data. Ideally, 100% of the data should be available. However, the possibility of unavailable data due to accidents, insufficient sample volume, broken or lost samples, etc. is to be expected. Therefore, it will be a general goal of the project that 90% data completion is achieved.

A8 SPECIAL TRAINING/CERTIFICATION

New field personnel receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they demonstrate to the GBRA Data Manager their ability to properly calibrate field equipment and perform field sampling and analysis procedures. Field personnel training is documented and retained in the personnel file and are available during a monitoring systems audit.

Contractors and subcontractors must ensure that laboratories analyzing samples under this QAPP meet the requirements contained in section 5.4.4 of the NELAC® standards (concerning Review of Requests, Tenders and Contracts).

A9 DOCUMENTS AND RECORDS

The documents and records that describe, specify, report, or certify activities are listed. These reports may or may not be kept in paper form since the reports can be regenerated from the lab database at any time. If kept in paper form, the paper form is kept for a minimum of one year and then scanned into the GBRA Tab Fusion Archiving System for permanent record.

The GBRA laboratory database is housed on the laboratory computer and is backed up on the network server nightly. A back up copy of the network server files, including the GBRA Tab Fusion Archiving System, is made every Monday and that copy is stored off-site at a protected location. The GBRA Network Administrator is responsible for the servers and back up generation.

All monitoring analysis data generated by the GBRA laboratory is recorded on electronic bench sheets or in electronic instrument files. The results from these files are transferred into the GBRA laboratory information system (LIMS) with an electronic parsing program. Electronic bench sheets and instrument files associated with monitoring data are archived for at least 5 years.

The GBRA Field Technician uses a computer to record field data and instrument calibration logs onto electronic data sheets. The GBRA Field Technician transfers the data that they record on electronic field sheets into the GBRA laboratory information system (LIMS) with an electronic parsing program. The GBRA Field Technician saves the electronic data sheets associated with monitoring data for at least 5 years. Alternatively, the GBRA Field Technician may record field data and instrument calibrations on paper data sheets. The GBRA Field Technician transcribes the data from the paper field sheets into the GBRA LIMS manually. The GBRA field technician retains paper data sheets for at least one month, and then transfers the files to GBRA records retention staff for long term electronic archiving. The GBRA Field Technician will determine the method in which field data is collected based upon electronic equipment availability and access to wireless communications.

Table A9.1 Project Documents and Records

Document/Record	Location	Retention (yrs)	Format
QAPPs, amendments and appendices	TSSWCB/GBRA	One Month/ 5 Years	Paper/ Electronic
QAPP distribution documentation	GBRA	One Month/ 5 Years	Paper/ Electronic
QAPP commitment letters	GBRA	One Month/ 5 Years	Paper/ Electronic
Field notebooks or data sheets	GBRA	One Month/ 5 Years	Paper/ Electronic
Field staff training records	GBRA	One Month/ 5 Years	Paper/ Electronic
Field equipment calibration/maintenance logs	GBRA	One Month/ 5 Years	Paper/ Electronic

COC records	GBRA /Ana-Lab	One Month/ 5 Years	Paper/ Electronic
Field SOPs	GBRA	5 Years	Electronic
Laboratory QA Manuals	GBRA /Ana-Lab	5 Years	Electronic
Laboratory SOPs	GBRA /Ana-Lab	5 Years	Electronic
Laboratory data reports/results	GBRA /Ana-Lab	5 Years	Electronic
Laboratory staff training records	GBRA /Ana-Lab	One Month/ 5 Years	Paper/ Electronic
Instrument printouts	GBRA /Ana-Lab	One Month/ 5 Years	Paper/ Electronic
Laboratory equipment maintenance logs	GBRA /Ana-Lab	One Month/ 5 Years	Paper/ Electronic
Laboratory calibration records	GBRA /Ana-Lab	One Month/ 5 Years	Paper/ Electronic
Corrective Action Documentation	GBRA /Ana-Lab	One Month/ 5 Years	Paper/ Electronic

The TSSWCB may elect to take possession of records at the conclusion of the specified retention period.

Laboratory Test Reports

Test/data reports from the laboratory must document the test results clearly and accurately. Routine data reports should be consistent with the TNI Volume 1, Module 2, Section 5.10 and include the information necessary for the interpretation and validation of data. The requirements for reporting data and the procedures are provided.

A laboratory test report is generated upon request by the laboratory information system. A test report should be consistent with the current TNI standards and will include the following information necessary for the GBRA review, verification, validation and interpretation of data process documented in sections D1 and D2 of this document:

- title of report and unique identifiers on each page
- name and address of the laboratory
- name and customer number of the client
- a clear identification of the sample(s) analyzed
- station information (SLOC number)
- date and time of sample receipt
- date and time of collection
- identification of method used
- identification of samples that did not meet QA requirements and why (e.g., holding times exceeded)
- sample results
- units of measurement
- sample matrix
- dry weight or wet weight (as applicable)
- clearly identified subcontract laboratory results (as applicable)
- a name and title of person accepting responsibility for the report

- project-specific quality control results to include field split results (as applicable); equipment, trip, and field blank results (as applicable); and LOQ and LOD confirmation (% recovery)
- narrative information on QC failures or deviations from requirements that may affect the quality of results or is necessary for verification and validation of data
- certification of NELAP compliance on a result by result basis.

Electronic Data

Data collected under routine, targeted, diurnal and spring monitoring tasks will be submitted electronically to the TCEQ in the pipe-delineated Event/Result file format described in the most current version of the DMRG, which can be found at http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wdma/dmrg_index.html. A completed Data Review Checklist and Data Summary (see Appendix D) will be submitted with each data submittal.

All reported data resulting from monitoring events will have a unique TagID (see DMRG). Data collected under this QAPP has been assigned the tag prefix of “TX”. TagIDs used in this project will be seven-character alphanumerics with the structure of the two-letter Tag prefix followed by a four digit number.

Submitting Entity, Collecting Entity, and a 4- Character Monitoring Type codes will reflect the project organization and monitoring type in accordance with the DMRG. The proper coding of Monitoring Type is essential to accurately capture any bias toward certain environmental condition as well as the purpose of the project. The TSSWCB Project Manager and the TCEQ SWQMIS Data Manager should be consulted to assure proper use of the Monitoring Type code.

Table A9.2 Tag Prefixes and Monitoring Type Codes

Sample Description	**Tag Prefix**	**Submitting Entity**	**Collecting Entity**	**Monitoring Type Code**
Routine Monitoring	TX	TX	GB	RTWD
Targeted Monitoring	TX	TX	GB	BFBA
Diurnal Monitoring	TX	TX	GB	BSWD
Spring Monitoring	TX	TX	GB	BSWD

Amendments to the QAPP

Revisions to the QAPP may be necessary to address incorrectly documented information or to reflect changes in project organization, tasks, schedules, objectives, and methods. Requests for amendments will be directed from the GBRA Project Manager to the TSSWCB Project Manager electronically. Amendments are effective immediately upon approval by the GBRA Project Manager, the GBRA Laboratory QAO, the TSSWCB Project Manager, and the TSSWCB QAO. They will be incorporated into the QAPP by way of attachment and distributed to personnel on the distribution list by the GBRA Project Manager.

B1 SAMPLING PROCESS DESIGN

The sample design is based on the intent of this project as recommended by the PCWP Steering Committee. Under their direction, the TSSWCB and GBRA have been tasked with providing data to characterize water quality conditions in support of the 305(b) assessment, and to identify significant long-term water quality trends. Based on PCWP Steering Committee input, achievable water quality objectives and priorities and the identification of water quality issues were used to develop the work plan, which are in accord with available resources. As part of the PCWP Steering Committee process, the TSSWCB and GBRA coordinate closely with other participants to ensure a comprehensive water monitoring strategy within the watershed.

Routine monitoring will complement existing routine ambient monitoring being conducted by GBRA. The four routine monitoring sites (non-CRP) have been selected to increase the spatial distribution of data. Monthly routine monitoring includes the conventional, bacterial and field parameter groups (*E. coli*, pH, DO, temperature, specific conductance, chloride, sulfate, chlorophyll a, pheophytin, nitrate-nitrogen, ammonia-nitrogen, total hardness, TSS, turbidity, Total Phosphorus and Total Kjeldahl Nitrogen) that are currently collected at the three existing sites being monitored by GBRA under the CRP program. Analytical results will be used in assessments conducted by TCEQ and compared to historical data at the existing monitoring locations in the watershed. Stream flow will be measured by the USGS gaging station for site 12640. Flow at the remaining routine sites will be measured manually (mechanically, electronically or by Acoustic Doppler.)

In addition to routine monitoring at these locations, 24-hour diurnal monitoring will be conducted once per month during the index period months, March through October. Dissolved oxygen, pH, temperature, and specific conductance will be recorded hourly through the diurnal cycle. Flow will be measured using the nearest USGS gage station or measured manually at the time of data sonde deployment or retrieval. Minimum, maximum, range, average (not pH) and number of measurements will be reported for each parameter.

Sites for targeted monitoring were selected to represent spatial, seasonal and meteorological conditions throughout the Plum Creek Watershed and contributing subwatersheds. The targeted monitoring regime is designed to evaluate the effectiveness of BMPs (both rural and urban) across the watershed and measure their impacts on in-stream water quality. Sampling will be conducted two times per quarter for 11 quarters, once under dry weather conditions and once during wet weather conditions. The 7 routine monitoring stations will only be resampled during targeted monitoring if they have not already been collected during the targeted weather conditions. Targeted monitoring stations will be sampled for conventional, field and flow parameter groups. Conventional parameters for targeted monitoring will be limited to total suspended solids, nitrate nitrogen, ammonia nitrogen, total kjeldahl nitrogen, and total phosphorus. The area has been known to experience scattered showers, i.e., afternoon heat-related showers of short duration that may cause some portions of the watershed to be under wet weather conditions while others are not. Targeted monitoring sites will be visited when the overall watershed is under the specific weather conditions, dry or wet. There may be times, during dry weather conditions, when there is no water in the stream in the subwatersheds. Those visits will be documented but no stream data will be collected. During wet weather conditions, the safety of the sampling crew will not be compromised in case of lightning or flooding. In the instance that a sampling site is inaccessible due to weather conditions or flooding, “no sample due to inaccessibility” will be documented in the field notebook. The routine monitoring sites will be targeted for wet weather conditions during each quarter if none of the routine monitoring events conducted met those conditions during that quarter, or targeted for dry conditions if those conditions were not met during that quarter.

Seven WWTFs will be sampled once per month for 33 months. Data will be collected to characterize the wastewater facilities’ contributions to the flow regime and pollutant loading. Samples will be collected at the outfall of each facility, before it mixes with the receiving stream. Parameters will include flow, field, bacteria and routine conventional parameters, including the effluent parameters BOD, CBOD and COD. The WWTFs measure the effluent flow in million gallons per day. At the time of sampling, the flow will be obtained from the WWTF and converted to cubic feet per second.

Three spring flow sites have been identified using local and historical knowledge. GBRA will conduct spring flow monitoring at the 3 springs once per quarter collecting field, conventional, flow and bacteria parameter groups. Conventional parameters for spring stations are total suspended solids, sulfate, chloride, nitrate nitrogen, ammonia nitrogen, total kjehldahl nitrogen and total phosphorus. Sampling period extends through 11 quarterss. The data will be collected at a location that is in the closest proximity to the headwaters of each spring and with enough depth to collect a representative sample. Care will be given to sample above stream features such as riffles that could influence water quality after the spring emerges from the ground. Flow will be measured manually at each spring.

B2 SAMPLING METHODS

Field Sampling Procedures

Field sampling will be conducted according to procedures documented in the *TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue: RG-415 (August 2012* or the most recent version) and and Volume 2: *Methods for Collecting and Analyzing Biological Assemblage and Habitat Data: RG-416 (May 2014 or the most recent version)*, collectively referred to as "SWQM Procedures." any interim changes posted to the Surface Water Quality Monitoring Procedures website (http://www.tceq.texas.gov/waterquality/monitoring/swqm_guides.html). Updates shall be incorporated into program procedures, QAPP, SOPs, etc., within 60 days of any final published version. All following references to "TCEQ Surface Water Quality Monitoring Procedures," "TCEQ Surface Water Quality Monitoring Procedures as amended," "SWQM Procedures," "SWQM Procedures Manual," "*TCEQ Surface Water Quality Monitoring Procedures Volume 1 (RG-415)," and "TCEQ Surface Water Quality Monitoring Procedures Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data (RG-416)," refer to this section and are used interchangeably*. Additional aspects outlined in Section B below reflect specific requirements for sampling under this project and/or provide additional clarification.

Table B2.1 Sample Storage, Preservation and Handling Requirements

Parameter	Matrix	Container	Preservation*	Sample Volume	Holding Time
Turbidity	Water	Plastic or glass	Cool, 0-6ºC	3L	48 hours
Hardness	Water	Plastic or glass	Cool, 0-6ºC, H_2SO_4 to pH < 2*	1 L	28 days
TSS	Water	Plastic or glass	Cool, 0-6ºC	3 L	7 days
Nitrate-nitrogen	Water	Plastic or glass	Cool, 0-6ºC	3 L	48 hours
Ammonia-nitrogen	Water	Plastic or glass	Cool, 0-6ºC, H_2SO_4 to pH < 2*	1 L	28 days
Total Kjeldahl Nitrogen	Water	Plastic or glass	Cool, 0-6ºC, H2SO4 to pH < 2*	1 L	28 days
Total Phosphorus	Water	Plastic or glass	Cool, 0-6ºC, H_2SO_4 to pH < 2*	1 L	28 days
Sulfate	Water	Plastic or glass	Cool, 0-6ºC	3 L	28 days
Chloride	Water	Plastic or glass	Cool, 0-6ºC	3 L	28 days
Chlorophyll a /Pheophytin	Water	Amber plastic or glass	Dark, Cool, 0-6ºC before filtration; Dark, 0ºC after filtration	3 L	Filter within 48 hours/28 days at 0ºC
*E. coli***	Water	Sterile, plastic	Cool, 0-6ºC (with $Na_2S_2O_3$ at chlorinated discharges)*	120 mL	8 hours
BOD	Water	Plastic	Cool, 0-6ºC	4 L	48 hours
C-BOD	Water	Plastic	Cool, 0-6ºC	4 L	48 hours
COD	Water	Plastic	Cool, 0-6ºC, H_2SO_4 to pH < 2*	1 L	28 days
Biological Fish	Surface Water	Plastic	10% Formalin (field)*/ 70%-75% Ethyl Alcohol (Voucher)	500 mL (field)*	Surface Water
Biological BenthicMacro-invertebrates	Surface Water	Plastic	70% or 95% Ethyl Alcohol (field)* */ 70%-75% Ethyl Alcohol (voucher)	500 mL (field)* /5 mL (voucher)	1 week (field)*; 5 years (voucher)

* Preservation occurs within 15 minutes of sample collection in a pre-preserved container.
** *E.coli* samples analyzed by Colilert-18 or SM 9223-B should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 8 hours, the holding time may be extended and samples must be processed as soon as possible and within 24 hours.

Sample Containers

GBRA

GBRA purchases new bottles for all samples collected for this project. GBRA maintains certificates from sample container manufacturers for purchased bottles in a notebook located in the GBRA laboratory.

- Sample containers for unpreserved conventional parameters such as TSS, NO_3-N, Turbidity, Chloride, Sulfate, Chlorophyll a and Pheophytin are disposable plastic three-liter amber bottles that GBRA purchases new.
- Sample containers for parameters preserved with H_2SO_4 such as TKN, NH_3-N, Total Phosphorus and Total Hardness are disposable one-liter plastic bottles pre-preserved with 2 mL of sulfuric acid that the GBRA purchases new.
- Sample containers for bacteria parameters such as *E. coli* are 120 mL sterile bottles. GBRA collects bacteriological samples in bottles without sodium thiosulfate for most monitoring locations. Samples collected immediately downstream of chlorinated discharges are collected in bottles preserved with sodium thiosulfate.
- GBRA collects sample containers with 10% formalin for biological fish vouchers in the field. These samples are stored for at least 1 week and then washed and soaked in tap water for three successive days. Following this washing procedure, GBRA transfers the fish to bottles containing 70-75% Ethyl Alcohol to serve as vouchers for each fish species collected. Photographic vouchers may be substituted for physical specimens if appropriate.
- GBRA collects sample containers with 70-75 Ethyl Alcohol for biological benthic macroinvertebrates assemblages in the field. These samples are stored at room temperature until the sample is processed. Following identification procedures, GBRA transfers the benthic macroinvertebrates to 5 mL bottles containing 70-75% Ethyl Alcohol to serve as vouchers for each genus collected.

Ana-Lab

Ana-Lab purchases new bottles for all samples distributed to GBRA, for TSSWCB analysis performed as a part of this QAPP. Ana-lab maintains manufacturer certificates for any bottles distributed to collecting entities in this QAPP.

Processes to Prevent Contamination

Procedures in the TCEQ *SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue: RG-415 (August 2012 or most recent version)* outline the necessary steps to prevent contamination of samples, including direct collection into sample containers, when possible. Field QC samples, where applicable, (identified in Section B5) are collected to verify that contamination has not occurred.

Documentation of Field Sampling Activities

Field sampling activities are documented on paper or electronic field data sheets as presented in Appendix B. Data from paper field data sheets are transcribed into the laboratory information system or an Excel spreadsheet. GBRA transfers data from electronic field data sheets directly into the laboratory information system via a parsing program or transcribes data from paper field sheets into the laboratory information system. Flow worksheets, aquatic life use monitoring checklists, habitat assessment forms, field biological assessment forms, and records of bacteriological analyses (if applicable) are part of the field data record. The following will be recorded for all visits:

- Station ID
- Sampling date
- Location
- Sampling depth
- Sampling time
- Sample collector's initials
- Values for all field parameters, including flow and flow severity
- Detailed observational data, including:
  - water appearance
  - weather
  - biological activity
  - unusual odors
  - pertinent observations related to water quality or stream uses (i.e., exceptionally poor water quality conditions/standards not met; stream uses such as swimming, boating, fishing, irrigation pumps)
  - watershed or instream activities (i.e., bridge construction, livestock watering upstream)
- missing parameters (i.e., when a scheduled parameter or group of parameters is not collected)

Recording Data

For the purposes of this section and subsequent sections, all field and laboratory personnel follow the basic rules for recording information as documented below:

- Write legibly, in indelible ink (paper data sheets only).
- Make changes to paper pages by crossing out original entries with a single line strike-out, entering the changes, and initialing and dating the corrections (paper data sheets only).
- Close-out incomplete paper pages with an initialed and dated diagonal line (paper data sheets only).
- GBRA saves electronic field data sheets as PDF files for at least 5 years
- GBRA PDF files are electronically time stamped at the time that they are created and cannot be revised. If data on an electronic field needs to be corrected, a new time stamped PDF file is created and both files are retained for at least 5 years.
- GBRA saves electronic laboratory instrumentation calibration and analysis files for at least 5 years.

Sampling Method Requirements or Sampling Process Design Deficiencies, and Corrective Action

Examples of sampling method requirements or sample design deficiencies include but are not limited to such things as inadequate sample volume due to spillage or container leaks, failure to preserve samples appropriately, contamination of a sample bottle during collection, storage temperature and holding time exceedance, sampling at the wrong site, etc. Any deviations from the QAPP, SWQM Procedures, or appropriate sampling procedures may invalidate data, and require documented corrective action. Corrective action may include for samples to be discarded and re-collected. It is the responsibility of the GBRA Project Manager, in consultation with the GBRA QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TSSWCB Project Manager both verbally and in writing in the project progress reports and by completion of a Corrective Action Report (CAR).

Deficiencies are documented in logbooks, field data sheets, etc., by field or laboratory staff and reported to the field or laboratory supervisor who will notify the GBRA Project Manager. The GBRA Laboratory QAO or GBRA Project Manager will initiate a CAR to document the deficiency. The definition of and process for handling deficiencies and corrective action are defined in Section C1

B3 SAMPLE HANDLING AND CUSTODY

Sample Tracking

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, and analysis.

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The COC form is a record that documents the possession of the samples from the time of collection to receipt in the laboratory. The following information concerning the sample is recorded on the COC form (See Appendix C). The following list of items matches the COC form in Appendix C.

- Date and time of collection
- Site identification
- Sample matrix
- Number of containers and respective volumes
- Preservative used or if the sample was filtered
- Analyses required
- Name of collector
- Custody transfer signatures and dates and time of transfer
- Bill of lading (if applicable)
- Subcontract laboratory, if used

Sample Labeling

Samples from the field are labeled on the container with an indelible marker. Label information includes:

- Site identification
- Date and time of sampling
- Preservative added, if applicable
- Designation of "field-filtered" as applicable
- Sample type (i.e., routine, targeted, spring)

Sample Handling

After collection of samples are complete, sample containers are immediately stored in an ice chest for transport to the GBRA laboratory, accompanied by the COC form. Ice chests will remain in the possession of the field technician or in the locked vehicle until delivered to the lab. After receipt at the GBRA lab, the samples are stored in the refrigeration unit or given to the analyst for immediate analysis. Only authorized laboratory personnel will handle samples received by the laboratory. Samples shipped to Ana-lab via common carrier will initially be transferred to the GBRA laboratory and then packaged and shipped with a new chain of custody by GBRA laboratory personnel. Samples that necessitate delivery to Ana-lab on the day of collection in order to meet holding times, will be transferred directly to those laboratories by GBRA field personnel.

Sample Tracking Procedure Deficiencies and Corrective Action

All deficiencies associated with COC procedures, as described in this QAPP, are immediately reported to the Basin Planning Agency Project Manager. These include such items as delays in transfer resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc.

Depending upon the severity of the deficiency or potential impact to reportable data, the GBRA project manager in consultation with the GBRA QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate the data and the sampling event should be repeated, if possible. The resolution of the situation will be reported to the TSSWCB Project Manager in the project progress report. CARs will be prepared by the GBRA QAO or GBRA Project Manager and submitted to the TSSWCB Project Manager along with the project progress report.

Deficiencies are documented on Chain of Custodies, logbooks, field data sheets, etc., by field or laboratory staff and reported to the field or laboratory supervisor who will notify the GBRA Project Manager. The GBRA Laboratory QAO or GBRA Project Manager will initiate a CAR to document the deficiency. The definition of and process for handling deficiencies and corrective action are defined in Section C1.

B4 ANALYTICAL METHODS

The analytical methods, associated matrices, and performing laboratories are listed in Table A7.1. The authority for analysis methodologies under this project is derived from the TSWQS (Texas Administrative Code §§307.1 - 307.10) in that data generally are generated for comparison to those standards and/or criteria. The standards state that "Procedures for laboratory analysis must be in accordance with the most recently published edition of the book entitled Standard Methods for the Examination of Water and Wastewater, the TCEQ Texas Surface Water Quality Monitoring Procedures as amended, 40 CFR Part 136, or other reliable procedures acceptable to the commission, and in accordance with Chapter 25 of this title."

Laboratories collecting data under this QAPP are compliant with the NELAC® standards, at a minimum. Copies of laboratory QASMs and SOPs are available for review by the TSSWCB.

Standards Traceability

All standards used in the field and laboratory are traceable to certified reference materials. Standards preparation is fully documented and maintained in a standards log book. Each documentation includes information concerning the standard identification, starting materials, including concentration, amount used and lot number; date prepared, expiration date and preparer's initials/signature. The reagent bottle is labeled in a way that will trace the reagent back to preparation. Table A7 lists the methods to be used for field and laboratory analyses.

Analytical Method Deficiencies and Corrective Actions

Deficiencies in field and laboratory measurement systems involve, but are not limited to such things as instrument malfunctions, failures in calibration, blank contamination, quality control samples outside QAPP defined limits, etc. In many cases, the field technician or lab analyst will be able to correct the problem. If the problem is resolvable by the field technician or lab analyst, then they will document the problem on the field data sheet or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the GBRA Laboratory Supervisor, who will make the determination and notify the GBRA QAO and GBRA Project Manager. If the analytical system failure may compromise the sample results, the resulting data will not be reported to the TCEQ. The nature and disposition of the problem is reported on the data report which is sent to the GBRA Project Manager. The GBRA Project Manager will include this information in the CAR and submit with the Progress Report which is sent to the TSSWCB Project Manager.

The definition of and process for handling deficiencies and corrective action are defined in Section C1.

The TCEQ has determined that analyses associated with the qualifier codes (e.g., "holding time exceedance", "sample received unpreserved", "estimated value") may have unacceptable measurement uncertainty associated with them. This will immediately disqualify analyses from submittal to SWQMIS. Therefore, data with these types of problems should not be reported to the TCEQ SWQMIS Database. Additionally, any data collected or analyzed by means other than those stated in this QAPP, or data suspect for any reason should not be submitted for loading and storage in SWQMIS. However, when data is lost, its absence will be described in the data summary report submitted with the corresponding data set, and a corrective action plan (as described in section C1) may be necessary.

B5 QUALITY CONTROL

Sampling Quality Control Requirements and Acceptability Criteria

The minimum Field QC Requirements are outlined in the TCEQ *SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue: RG-415 (August 2012 or most recent version)*. Specific requirements are outlined below.
No Field QC samples will be collected for this project.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Batch

A batch is defined as environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same NELAP-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 25 hours. An analytical batch is composed of prepared environmental samples (extract, digestates, or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Method Specific QC requirements

QC samples, other than those specified later this section, are run (e.g., sample duplicates, surrogates, internal standards, continuing calibration samples, interference check samples, positive control, negative control, and media blank) as specified in the methods and in SWQM Procedures. The requirements for these samples, their acceptance criteria or instructions for establishing criteria, and corrective actions are method-specific.

Detailed laboratory QC requirements and corrective action procedures are contained within the individual laboratory quality manuals (QASMs). The minimum requirements that all participants abide by are stated below.

Comparison Counting

For routine bacteriological samples, repeat counts on one or more positive samples are required, at least monthly. If possible, compare counts with an analyst who also performs the analysis. Replicate counts by the same analyst should agree within 5 percent, and those between analysts should agree within 10 percent. Record the results.

<u>Limit of Quantitation (LOQ)</u> – The LOQ is used to establish intra-laboratory bias to assess the performance of the measurement system at the lower limits of analysis. The laboratory will analyze a calibration standard (if applicable) at the LOQ specified in Table A7. An LOQ will be verified annually for each matrix and analyte on each instrument. Additionally, LOQs may be verified using the analyst's best professional judgment whenever a significant change in instrument response is observed or expected (i.e. after preventative maintenance, major repair or

unusual responses are observed.) Calibrations including the standard at the LOQ listed in Table A7 will meet the calibration requirements of the analytical method or corrective action will be implemented.

LOQ Check Standard – An LOQ check sample consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system at the lower limits of analysis. The LOQ check sample is spiked into the sample matrix at a level less than or near the LOQ specified in Table A7. The LOQ check sample will be verified annually for each matrix and analyte on each instrument. Additionally, LOQ check samples may be verified using the analyst's best professional judgment whenever a significant change in instrument response is observed or expected (i.e. after preventative maintenance, major repair or unusual responses are observed.) If it is determined that samples have exceeded the high range of the calibration curve, samples should be diluted or run on another curve. For samples run on batches with calibration curves that do not include the LOQ specified in Table A7, a check sample will be run at the low end of the calibration curve.

The LOQ check sample is carried through the complete preparation and analytical process. LOQ Check Samples are run at a rate of one per analytical batch.

The percent recovery of the LOQ check sample is calculated using the following equation in which %R is percent recovery, SR is the sample result, and SA is the reference concentration for the check sample:

$$\%R = \frac{S_R}{S_A} \times 100$$

Measurement performance specifications are used to determine the acceptability of LOQ Check Sample analyses as specified in Table A7.

LOQ Check Standard – An LOQ check sample consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system at the lower limits of analysis. The LOQ check sample is spiked into the sample matrix at a level less than or near the LOQ specified in Table A7. The LOQ check sample will be verified annually for each matrix and analyte on each instrument. Additionally, LOQ check samples may be verified using the analyst's best professional judgment whenever a significant change in instrument response is observed or expected (i.e. after preventative maintenance, major repair or unusual responses are observed.) If it is determined that samples have exceeded the high range of the calibration curve, samples should be diluted or run on another curve. For samples run on batches with calibration curves that do not include the LOQ specified in Table A7, a check sample will be run at the low end of the calibration curve.

The LOQ check sample is carried through the complete preparation and analytical process. LOQ Check Samples are run at a rate of one per analytical batch.

$$\%R = \frac{S_R}{S_A} \times 100$$

The percent recovery of the LOQ check sample is calculated using the following equation in which %R is percent recovery, SR is the sample result, and SA is the reference concentration for Measurement performance specifications are used to determine the acceptability of LOQ Check Sample analyses as specified in Table A7.

Laboratory Control Sample (LCS)

An LCS consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system. The LCS is spiked into the sample matrix at a level less than or near the midpoint of the calibration for each analyte. In cases of test methods with very long lists of analytes, LCSs are prepared with all the target analytes and not just a representative number, except in cases of organic analytes with multipeak responses.

The LCS is carried through the complete preparation and analytical process. LCSs are run at a rate of one per preparation batch.

Results of LCSs are calculated by percent recovery (%R), which is defined as 100 times the measured concentration, divided by the true concentration of the spiked sample.

The following formula is used to calculate percent recovery, where %R is percent recovery; SR is the measured result; and SA is the true result:

$$\%R = \frac{S_R}{S_A} \times 100$$

Measurement performance specifications are used to determine the acceptability of LCS analyses as specified in Table A7.

Laboratory Duplicates

A laboratory duplicate is an aliquot taken from the same container as an original sample under laboratory conditions and processed and analyzed independently. A laboratory duplicate is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. Laboratory duplicates are used to assess precision and are performed at a rate of one per preparation batch.

For most parameters except bacteria, precision is evaluated using the relative percent difference (RPD) between duplicate LCS results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X1 and X2, the RPD is calculated from the following equation: (If other formulas apply, adjust appropriately).

$$RPD = (X_1 - X_2)/\{(X_1 + X_2)/2\} * 100$$

For bacteriological parameters, precision is evaluated using the results from laboratory duplicates. Bacteriological duplicates are collected on a 10% frequency (or once per sampling run, whichever is more frequent). These duplicates will be collected in sufficient volume for analysis of the sample and its laboratory duplicate from the same container.

The base-10 logarithms of the result from the original sample and the result from its duplicate will be calculated. The absolute value of the difference between the two logarithms will be calculated, and that difference will be compared to the precision criterion in Table A7.

If the range of the logarithms of the sample and the duplicate are less than or equal to the precision criterion, then only the value of the sample is reported. The duplicate is not reported as a sample, and is not averaged with the sample.

In the event that elevated bacteria concentrations are anticipated (i.e. samples collected after a rain event), the analysis is performed with the appropriate dilution volume including an identically diluted duplicate. When the samples are incubated and read, the values for the sample and the duplicate are multiplied by the dilution factor to determine the MPN value adjusted to the original volume. The log range is compared to the precision criterion as above. If it passes, then only the value of the sample, adjusted for dilution, is reported to TSSWCB.

If the difference in logarithms is greater than the precision criterion, the data are not acceptable for use under this project and will not be reported to TSSWCB. Results from all samples associated with that failed duplicate (usually a maximum of 10 samples) will be considered to have excessive analytical variability and will be qualified as not meeting project QC requirements.

The precision criterion in Table A7 for bacteriological duplicates applies only to samples/sample duplicates with concentrations > 10 MPN/100mL.

<u>Matrix spike (MS)</u> –Matrix spikes are prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Percent recovery of the known concentration of added analyte is used to assess accuracy of the analytical process. The spiking occurs prior to sample preparation and analysis. Spiked samples are routinely prepared and analyzed at a rate of 10% of samples processed, or one per analytical batch whichever is greater. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples. The information from these controls is sample/matrix specific and is not used to determine the validity of the entire batch. The MS is spiked at a level less than or equal to the midpoint of the calibration or analysis range for each analyte. Percent recovery (%R) is defined as 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike.

The results from matrix spikes are primarily designed to assess the validity of analytical results in a given matrix and are expressed as percent recovery (%R). The laboratory shall document the calculation for %R. The percent recovery of the matrix spike is calculated using the following equation in which %R is percent recovery, SSR is the observed spiked sample concentration, SR is the sample result, and SA is the reference concentration of the spike added:

$$^{S}SR\ ^{-S}R$$

$$\%R = \times 100$$

$$SA$$

Measurement performance specifications for matrix spikes are not specified in this document.

Matrix spike recoveries are compared to the same acceptance criteria established for the associated LCS recoveries, rather than the matrix spike recoveries published in the mandated test method. The EPA 1993 methods (i.e. ammonia-nitrogen, ion chromatography, TKN) that establish matrix spike recovery acceptance criteria are based on recoveries from drinking water that has very low interferences and variability and do not represent the matrices sampled in this project. If the matrix spike results are outside laboratory-established criteria, there will be a review of all other associated quality control data in that batch. If all of quality control data in the associated batch passes, it will be the decision of the GBRA Laboratory QAO and/or GBRA Project Manager to report the data for the analyte that failed in the parent sample to TSSWCB or to determine that the result from the parent sample associated with that failed matrix spike is considered to have excessive analytical variability and does not meet project QC requirements. Depending on the similarities in composition of the samples in the batch, GBRA may consider excluding all of the results in the batch related to the analyte that failed recovery.

<u>Method blank</u> –A method blank is a sample of matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as the samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the LOQ. For very high-level analyses, the blank value should be less than 5% of the lowest value of the batch, or corrective action will be implemented.

Quality Control or Acceptability Requirements Deficiencies and Corrective Actions

Sampling QC excursions are evaluated by the GBRA Project Manager, in consultation with the GBRA Laboratory QAO. In that differences in sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on predetermined limits is not practical. Therefore, the professional judgment of the GBRA Project Manager and QAO will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Any sample QC deficiencies that are determined to result in a nonconformance, as described in section C1, will be documented by the GBRA Laboratory QAO or GBRA Project Manager on a Corrective Action Report (CAR) and reported to the TSSWCB Project Manager.

Additionally, in accordance with the TNI Standard (Volume 1, Module 2, Section 4.5, Subcontracting of Environmental Tests) when a laboratory that is a signatory of this QAPP finds it necessary and/or advantageous to subcontract analyses, the laboratory that is the signatory on this QAPP must ensure that the subcontracting laboratory is NELAP-accredited (when required) and understands and follows the QA/QC requirements included in this QAPP. This includes that the sub-contracting laboratory utilize the same reporting limits as the signatory laboratory and performs all required quality control analysis outlined in this QAPP. The signatory laboratory is also responsible for quality assurance of the data prior to delivering it to the GBRA or UGRA, including review of all applicable QC samples related to CRP data. As stated in section 4.5.5 of the TNI Standard, the laboratory performing the subcontracted work shall be indicated in the final report and the signatory laboratory shall make a copy of the subcontractor's report available to the client (GBRA) when requested.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

All sampling equipment testing and maintenance requirements are detailed in the TCEQ *SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue: RG-415 (August 2012 or most recent version) and TCEQ SWQM Procedures, Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data: RG-416 (May 2014 or most recent version)*. Sampling equipment is inspected and tested upon receipt and is assured appropriate for use. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QASM(s).

B7 INSTRUMENT CALIBRATION AND FREQUENCY

Field equipment calibration requirements are contained in the TCEQ *SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue: RG-415 (August 2012 or most recent version)*. Post-calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidate associated data collected subsequent to the pre-calibration and are not submitted to the TCEQ SWQMIS.

Detailed laboratory calibrations are contained within the QASM(s).

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

No special requirements for acceptance are specified for field sampling supplies and consumables. All field supplies and consumables are accepted upon inspection for breaches in shipping integrity.

All new shipments of field and laboratory supplies and consumables received by the GBRA laboratory are inspected upon receipt for damage, missing parts, expiration date, and storage and handling requirements. Chemicals, reagents, and standards are logged into an inventory database that documents grade, lot number, the manufacturer, dates received, opened, and emptied. All reagents shall meet ACS grade or equivalent where required. Acceptance criteria are detailed in organization's SOPs.

B9 NON-DIRECT MEASUREMENTS

USGS gage station data will be used throughout this project to aid in determining gage height and flow. Rigorous QA checks are completed on gage data by the USGS and the data are approved by the USGS and permanently stored at the USGS. This data will be submitted to the TCEQ under parameter code 00061 Flow, Instantaneous or parameter code 74069 Flow Estimate depending on the proximity of the monitoring station to the USGS gage station.

B10 DATA MANAGEMENT

Data Management Process

Field technicians and laboratory personnel follow protocols that ensure that data collected for this project maintains its integrity and usefulness in the WPP implementation process. The field technician pre-logs the samples to be collected into the GBRA laboratory information system, which generates separate and distinct sample tracking numbers. Field data collected and notes regarding sampling conditions at the time of the sampling event are logged by the field technician onto paper or electronic field data sheets. If a paper field sheet is created, then it is the responsibility of the field technician to transport it with the sample bottles to the laboratory. The separate and distinct sample numbers that the field technician generated for each sample during pre-logging procedures are confirmed upon sample receipt and new numbers are assigned as needed. The lab technician/sample custodian logs the sample into the Laboratory Information System (LIMS) Database. The sample is accompanied by a Chain of Custody (COC) form. The lab technician/sample custodian must review the COC to verify that it is filled out correctly and complete. Lab technicians/sample custodians take receipt of the sample and review the COC, begin sample prep or analysis and transfer samples into the refrigerator for storage. Examples of the field data sheet and COC form that may be used can be found in Appendices B and C. Field data that has been logged on paper field sheets is manually entered into the laboratory information system by the field technician, once the sample has been successfully received in the laboratory information system. Field data that has been logged on electronic field sheets is directly exported into the laboratory information system with a parsing program by the field technician, once the sample has been successfully received in the laboratory information system.

Data generated by lab technicians are either logged permanently on analysis bench sheets or logged directly into the GBRA laboratory information management system (LIMS). The generated data are reviewed by the analyst prior to entering the data into the LIMS Database. In the review, the analyst verifies that the data includes the correct date and time of analysis, that calculations are correct, that data includes documentation of dilutions and correction factors, that data meets Data Quality Objectives (DQOs) and that the data includes documentation of instrument calibrations, standard curves and control standards. A second review by another lab analyst/technician validates that the data meets the DQOs and that the data includes documentation of instrument calibrations, standard curves and control standards. After this review the lab analyst/technician inputs the verified data and QC information into the LIMS Database and/or verifies that it is ready for final quality assurance review, QAO approval, report generation and data storage.

The GBRA Laboratory Director supervises the GBRA laboratory. The Laboratory Director or QAO reviews the report that is generated when all analyses are complete. If the GBRA lab director or QAO feel there has been an error or finds that information is missing, the report is returned to the analyst for review and tracking to correct the error and generate a corrected copy. The GBRA Data Manager exports data from the GBRA LIMS, which converts the data to a pipe-delimited text file format acceptable for upload into SWQMIS as described in the latest DMRG. The GBRA Data Manager or designee reviews the respective data for reasonableness and if errors or anomalies are found the report is returned to the laboratory staff for review and tracking to correct the error. After the review for reasonableness, the data is verified to the analysis logs by the GBRA Data Manager. If at any time errors are identified, a supplemental laboratory sample number is created with the corrected data. The original sample and the supplemental sample are flagged with the associated sample numbers for sample tracking. The GBRA Data Manager or designee is responsible for transmitting the data to TSSWCB in the correct format. The GBRA LIMS database creates ASCII-formatted electronic data deliverable pipe-delimited text files for the event and results records for each sample and assigns a specific sequenced tag number that pairs the event and results files. The GBRA Data Manager or designee reviews the event and results file and removes non-TSSWCB data, confirms and corrects the program and source codes, checks data for correct significant figures and minimum and maximum data outliers. After the data are reviewed for completeness, minimum and maximum data outliers are accepted or rejected after being reviewed and confirmed for validity. The GBRA Data Manager uploads the text files to the SWQMIS test site to screen for data errors. If errors are found, GBRA Data Manager corrects the errors in the events and results files and saves the list of errors as electronic pdf documents.. The data files and Data Review Check List are sent to the TSSWCB Project Manager and TCEQ Data Manager for review and upload to the SWQMIS production environment. If errors are found after the TSSWCB and TCEQ review, those errors are corrected by the GBRA Data Manager and the relevant files are resubmitted to the TSSWCB Project Manager and TCEQ Data Manager.

Samples are taken to the Ana-Lab for analyses that cannot be performed by the GBRA laboratory. Data for samples that are outsourced to the or Ana-Lab is received in electronic or paper format. The data is reviewed by the GBRA QAO to confirm that all quality control criteria have been met. After the report has been approved by the GBRA QAO the written report is given to the GBRA Data Manager. The GBRA Data Manager reviews the data for reasonableness and if anomalies are found the Ana-Lab is contacted to confirm data. If data is confirmed the data is entered into the LIMS database and transmitted to TCEQ SWQMIS in the same way that the data generated by the GBRA laboratory and field data is transmitted.

Data Errors and Loss

The GBRA Laboratory Director supervises the GBRA laboratory. The GBRA Laboratory Director, Laboratory QAO or designee reviews the report that is generated when all analyses are complete. Again, the report is reviewed to see that all necessary information is included and that the DQOs have been met. If the GBRA Laboratory Director or GBRA Laboratory QAO feel there has been an error or finds that information is missing, the report is returned to the analyst for review and tracking to correct the error and generate a corrected copy. The GBRA Data Manager or designee reviews the data for reasonableness and if errors or anomalies are found the report is returned to the GBRA Laboratory Director or GBRA Laboratory QAO for review and tracking to correct the error. After review for reasonableness the data is cross-checked by the GBRA Data Manager or designee. If at any time errors are identified, the laboratory database is corrected and all affected participants are notified.If field or laboratory data are found to fail project QA criteria at any point during the data validation process, then the GBRA Project Manager may choose to have the affected data resampled in order to avoid a data loss.
To minimize the potential for data loss in the GBRA LIMS databases, both lab and server files are backed up nightly and copies of the files are stored off-site weekly. If the laboratory database or network server fails, the backup files can be accessed to restore operation or replace corrupted files.

Record Keeping and Data Storage

If data is collected and recorded on field data sheets, and not directly entered in the GBRA LIMS database by electronic parser, then the data sheets are filed for review and use later. These files are kept in paper form for a minimum of one month and then scanned and retained for at least five years. Electronic field data sheets are saved as pdf files and retained for a minimum of 5 years.

The data produced during each laboratory analysis is recorded on analysis bench sheets or entered directly into the GBRA LIMS database. The information contained on the bench sheet, or LIMS electronic file, includes all QC data associated with each day's or batch's analysis. The data from paper bench sheets and logs are transferred to the laboratory database for report generation. If paper analysis bench sheets are produced, then they are retained in paper form for a minimum of one month and then scanned and retained for at least 5 years.

The data reports that are generated are reviewed by the GBRA Laboratory Director or GBRA Laboratory QAO and signed. They are then given to the GBRA Project Manager for verification. If an anomaly or error is found the report is marked and returned to the laboratory for review, verification and correction, if necessary. If a correction is made, a tracking log is created in the LIMS. Laboratory reports can be regenerated from the lab database at any time as needed

The GBRA laboratory database is housed on the laboratory computer and is backed up on the network server nightly. A back up copy of the network server files is made every Friday and that copy is stored off-site at a protected location. The GBRA Network Administrator is responsible for the servers and back up generation.

After data is electronically submitted to the TSSWCB Project Manager and TCEQ Data Management and Analysis Team, the file that has been created is kept on the network server permanently. The network server is backed up nightly. Any paper copies of data review documentation that are generated by by the GBRA are kept or a minimum of one month and then scanned and retained as electronic copies for at least 5 years.

The database containing the scanned images of all lab records is contained on a network server and backed up nightly. A back-up copy of the network server files is made every Friday and that copy for GBRA is stored off-site at a protected location. The GBRA records manager is the custodian of these files.

Data Handling, Hardware, and Software Requirements

The laboratory database is housed on a GBRA server and backed up each evening. The laboratory database uses Microsoft Access and SQL 2012. The systems are operating in Windows 2010 and any additional software needed for word processing, spreadsheet or presentations uses Microsoft Office 2010.

Information Resource Management Requirements

Data will be managed in accordance with the DMRG, and applicable Basin Planning Agency information resource management policies.

GPS equipment may be used as a component of the information required by the Station Location (SLOC) request process for creating the certified positional data that will ultimately be entered into SWQMIS database. Positional data obtained by CRP grantees using a GPS will follow the TCEQ's OPP 8.11 and 8.12 policy regarding the collection and management of positional data. Positional data may be acquired with a GPS and verified with photo interpolation using a certified source, such as Google Earth or Google Maps. The verified coordinates and map interface can then be used to develop a new SLOC.
In lieu of entering certified GPS coordinates, positional data may be acquired with a GPS and verified with photo interpolation using a certified source, such as Google Earth or Google Maps. The verified coordinates and map interface can then be used to develop a new SLOC.

C1 ASSESSMENTS AND RESPONSE ACTIONS

The following table presents the types of assessments and response actions for data collection activities applicable to the QAPP.

Table C1.1 Assessments and Response Requirements

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	GBRA	Monitoring of the project status and records to ensure requirements are being fulfilled	Report to TSSWCB in Quarterly Progress Report
Monitoring Systems Audit of GBRA	Dates to be determined by TSSWCB	TSSWCB	Field sampling, handling and measurement; facility review; and data management as they relate to this project	30 days to respond in writing to the TSSWCB to address corrective actions
Laboratory Inspection	Dates to be determined by TSSWCB	TSSWCB	Analytical and QC procedures employed at the GBRA laboratory and the contracted laboratories	30 days to respond in writing to the TSSWCB to address corrective actions

Deficiencies, Nonconformances and Corrective Action

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies which affect quantity and/or quality and render the data unacceptable or indeterminate. Deficiencies related to field and laboratory measurement systems include, but are not limited to, instrument malfunctions, blank contamination, QC sample failures, etc.

Deficiencies are documented in Chain of Custodies, logbooks, field data sheets, etc. by field or laboratory staff and reported to the field or laboratory supervisor who will notify the GBRA Project Manager. The GBRA Project Manager will notify the GBRA Laboratory QAO of the potential nonconformance. The GBRA Laboratory QAO or GBRA Project Manager will initiate a Corrective Action Report (CAR) to document the deficiency if it is determined by the GBRA Project Manager to constitute a nonconformance.

The GBRA Project Manager, in consultation with GBRA Laboratory QAO, will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the CAR will be not be initiated and the potential deficiency will be noted on the final laboratory report. If it is determined a nonconformance does exist, the GBRA Project Manager in consultation with the GBRA Laboratory QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the GBRA Laboratory QAO or GBRA Project Manager by completion of a CAR.

CARs document: root cause(s); impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and the means by which completion of each corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately both verbally and in writing.

The GBRA Project Manager is responsible for implementing and tracking corrective action resulting from audit findings outlined in the audit report. Records of audit findings and corrective actions are maintained by both the TSSWCB and the GBRA Project Managers. Audit reports and corrective action documentation will be submitted to the TSSWCB with the Quarterly Progress Report.

If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work are specified in the agreements in contracts between participating organizations.

C2 REPORTS TO MANAGEMENT

Reports to GBRA Project Management

Laboratory data reports contain QC information so that this information can be reviewed by the GBRA Project Manager. After review, if the GBRA Project Manager finds no anomalies or questionable data, the process of data transmittal to TCEQ SWQMIS begins. Project status, assessments and significant QA issues will be dealt with by the GBRA Project Manager who will determine whether it will be included in reports to the TSSWCB Project Manager.

Reports to TSSWCB

All reports detailed in this section are contract deliverables and are transferred to the TSSWCB in accordance with contract requirements.

Quarterly Progress Report - Summarizes the GBRA's activities for each task; reports monitoring status, problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Monitoring Systems Audit Report and Response - Following any audit performed by the GBRA, a report of findings, recommendations and response is sent to the TSSWCB in the quarterly progress report.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

For the purposes of this document, the term verification refers to the data review processes used to determine data completeness, correctness, and compliance with technical specifications contained in applicable documents (i.e., QAPPs, SOPs, QASMs, analytical methods). Validation refers to a specific review process that extends the evaluation of a data set beyond method and procedural compliance (i.e., data verification) to determine the quality of a data set specific to its intended use.

All field and laboratory data will be reviewed and verified for integrity and continuity, reasonableness, and conformance to project requirements, and then validated against the project objectives and measurement performance specifications which are listed in Section A7. Only those data which are supported by appropriate QC data and meet the measurement performance specifications defined for this project will be considered acceptable, and will be reported to TCEQ SWQMIS.

D2 VERIFICATION AND VALIDATION METHODS

All field and laboratory data will be reviewed, verified and validated to ensure they conform to project specifications and meet the conditions of end use as described in Section A7 of this document.

Data review, verification, and validation will be performed using self-assessments and peer and management review as appropriate to the project task. The data review tasks to be performed by field and laboratory staff is listed in the first two sections of Table D.2, respectively. Potential errors are identified by examination of documentation and by manual examination of corollary or unreasonable data. If a question arises or an error is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues which can be corrected are corrected and documented. If an issue cannot be corrected, the task manager consults with higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected. Field and laboratory reviews, verifications, and validations are documented.

After the field and laboratory data are reviewed, another level of review is performed once the data are combined into a data set. This review step, as specified in Table D2.1, is performed by the GBRA Data Manager or designee. Data review, verification, and validation tasks to be performed on the data set include, but are not limited to, the confirmation of laboratory and field data review, evaluation of field QC results, additional evaluation of anomalies and outliers, analysis of sampling and analytical gaps, and confirmation that all parameters and sampling sites are included in the QAPP.

Another element of the data validation process is consideration of any findings identified during the monitoring systems audit conducted by the TSSWCB QAO. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. After the data are reviewed and documented, the GBRA Data Manager or designee validates that the data meet the DQOs of the project and are suitable for reporting to TCEQ SWQMIS.

If any requirements or specifications of this project are not met, based on any part of the data review, the responsible party should document the nonconforming activities (with a CAR) and submit the information to the GBRA Project Manager with the data. This information is communicated to the TSSWCB by the GBRA in the Data Summary. The data is not transmitted to TCEQ SWQMIS.

Table D2.1 Data Review Tasks

Field Data Review	Responsibility
Field data reviewed for conformance with data collection, sample handling and COC, analytical and QC requirements	GBRA Field Technicians
Post-calibrations checked to ensure compliance with error limits	GBRA Field Technicians
Field data calculated, reduced, and transcribed correctly	GBRA Data Manager
Laboratory Data Review	**Responsibility**
Laboratory data reviewed for conformance with data collection, sample handling and COC, analytical and QC requirements to include documentation, holding times, sample receipt, sample preparation, sample analysis, project and program QC results, and reporting	GBRA /Ana-Lab (Analysts & QAOs)
Laboratory data calculated, reduced, and transcribed correctly	GBRA /Ana-Lab (Analysts & QAOs) and GBRA Data Manager
LOQs consistent with requirements for AWRLs	GBRA /Ana-Lab (Analysts & QAOs) and GBRA Data Manager
Analytical data documentation evaluated for consistency, reasonableness and/or improper practices	GBRA /Ana-Lab (Analysts & QAOs) and GBRA Data Manager
Analytical QC information evaluated to determine impact on individual analyses	GBRA /Ana-Lab (Analysts & QAOs) and GBRA Data Manager
All laboratory samples analyzed for all parameters	GBRA /Ana-Lab (Analysts & QAOs) and GBRA Data Manager
Data Set Review	**Responsibility**
The test report has all required information as described in Section A9 of the QAPP	GBRA QAO and GBRA Data Manager
Confirmation that field and lab data have been reviewed	GBRA QAO and GBRA Data Manager
Data set (to include field and laboratory data) evaluated for reasonableness and if corollary data agree	GBRA Data Manager and GBRA Project Manager
Outliers confirmed and documented	GBRA Data Manager and GBRA Project Manager
Field QC acceptable (e.g., field splits and trip, field and equipment blanks)	GBRA Data Manager
Sampling and analytical data gaps checked and documented	GBRA Data Manager and GBRA Project Manager
Verification and validation confirmed. Data meets conditions of end use and are reportable	GBRA Data Manager and GBRA Project Manager

D3 RECONCILIATION WITH USER REQUIREMENTS

Data produced in this project, and data collected by other organizations (i.e., USGS, TCEQ, etc.), will be analyzed and reconciled with project data quality requirements. Data meeting project requirements will be used in the implementation and adaptive management of the Plum Creek WPP and will be submitted to the TCEQ SWQMIS.

Appendix A Sampling Process Design and Monitoring Schedule

Sample Design Rationale

The sample design is based on the intent of this project as recommended by the PCWP Steering Committee. Under their direction, the TSSWCB and GBRA have been tasked with providing data to characterize water quality conditions in support of the 305(b) assessment, and to identify significant long-term water quality trends. Based on PCWP Steering Committee input, achievable water quality objectives and priorities and the identification of water quality issues were used to develop the work plan, which are in accord with available resources. As part of the PCWP Steering Committee process, the TSSWCB and GBRA coordinate closely with other participants to ensure a comprehensive water monitoring strategy within the watershed.

Site Selection Criteria

This data collection effort involves monitoring routine water quality, using procedures that are consistent with the TCEQ SWQM program, for the purpose of data entry into the SWQMIS database maintained by the TCEQ. To this end, some general guidelines are followed when selecting sampling sites, as basically outlined below, and discussed thoroughly in the TCEQ *SWQM Procedures*, *Volume 1* (*RG-415*) and *SWQM Procedures*, *Volume 2 (RG-416)*. Overall consideration is given to accessibility and safety. All monitoring activities have been developed in coordination with the PCWP Steering Committee and with the TSSWCB.

1. Locate stream sites so that samples can be safely collected from the centroid of flow. Centroid is defined as the midpoint of that portion of stream width which contains 50 percent of the total flow. If few sites are available for a stream segment, choose one that would best represent the water body, and not an unusual condition or contaminant source. Avoid backwater areas or eddies when selecting a stream site.

2. Because historical water quality data can be very useful in assessing use attainment or impairment, those historical sites were selected that are on current or past monitoring schedules.

3. Routine monitoring sites were selected to bracket sources of pollution, influence of tributaries, changes in land uses, and hydrological modifications.

4. Sites should be accessible. When possible, stream sites should have a USGS stream flow gauge. If not, flow measurement will be made during routine and targeted monitoring visits.

Monitoring Sites

The Monitoring Table for this project is presented on the following pages.

Legend:

RTWD = Program code for routine samples; solely intended to understand the basic physical, environmental, and human elements of the watershed
BFBA = Program code for targeted monitoring samples (biased flow); related to BMP effectiveness monitoring
BSWD = Program code for diurnal monitoring conducted during index period (biased season); solely intended to understand the basic physical, environmental, and human elements of the watershed
DO 24hr = diurnal monitoring for DO, conductivity, temperature and pH; measurements taken every hour for 24 hours; includes minimum, maximum and average.
Bacteria = *E. coli*
Conventional = TSS, turbidity, sulfate (routine, spring & effluent only), chloride (routine, spring & effluent only), nitrate nitrogen, ammonia nitrogen, total kjeldahl nitrogen, chlorophyll a (routine only), pheophytin (routine only), total hardness (routine only), total phosphorus, BOD (effluent only), CBOD (effluent only) and COD (effluent only)
Flow = flow collected by gage, electric, mechanical or Doppler; includes severity
Field = pH, temperature, conductivity, DO

Sampling Site Locations and Monitoring Regime

TCEQ Station ID	Site Description	Workplan Task	Monitor Type	DO 24hr	Bacteria	Conventional	Flow	Field	AQHab	Benthics	Nekton	Comment
12556	Clear Fork Plum Creek at Salt Flat Road	3.1	RTWD		33	33	33	33				1
12556	Clear Fork Plum Creek at Salt Flat Road	3.2	BFBA		11	11	11	11				
12556	Clear Fork Plum Creek at Salt Flat Road	3.3	BSWD	22			22					
12556	Clear Fork Plum Creek at Salt Flat Road	3.6	BS				2	2	2	2	2	
12558	Elm Creek at CR 233	3.1	RTWD		33	33	33	33				1
12558	Elm Creek at CR 233	3.2	BFBA		11	11	11	11				
12558	Elm Creek at CR 233	3.3	BSWD	22			22					
12640	Plum Creek at CR 135	3.1	RTWD		33	33	33	33				1, 3
12640	Plum Creek at CR 135	3.2	BFBA		11	17	11	11				
12640	Plum Creek at CR 135	3.3	BSWD	22			22					
12640	Plum Creek at CR 135	3.6	BS				2	2	2	2	2	
12647	Plum Creek at Old McMahan Road (CR 202)	3.1	RTWD		33	33	33	33				1, 3
12647	Plum Creek at Old McMahan Road (CR 202)	3.2	BFBA		11	17	11	11				
12647	Plum Creek at Old McMahan Road (CR 202)	3.3	BSWD	22			22					
17406	Plum Creek at Plum Creek Road	3.1	RTWD		33	33	33	33				1, 3
17406	Plum Creek at Plum Creek Road	3.2	BFBA		11	17	11	11				
17406	Plum Creek at Plum Creek Road	3.3	BSWD	22			22					
20488	Brushy Creek at Rocky Road (Upstream of NRCS 14)	3.1	RTWD		33	33	33	33				1
20488	Brushy Creek at Rocky Road (Upstream of NRCS 14)	3.2	BFBA		11	11	11	11				
20488	Brushy Creek at Rocky Road (Upstream of NRCS 14)	3.3	BSWD	22			22					
20500	West Fork Plum Creek at Biggs Road (CR 131)	3.1	RTWD		33	33	33	33				
20500	West Fork Plum Creek at Biggs Road (CR 131)	3.2	BFBA		11	11	11	11				
20500	West Fork Plum Creek at Biggs Road (CR 131)	3.3	BSWD	22			22					
12555	Salt Branch at FM 1322	3.2	BFBA		22	22	22	22				
12557	Town Creek at E. Market St. (Upstream of Lockhart #I WWTP)	3.2	BFBA		22	22	22	22				
12559	Porter Creek at Dairy Road	3.2	BFBA		22	22	22	22				
12642	Plum Creek at Biggs Road (CR 131)	3.2	BFBA		22	22	22	22				
12643	Plum Creek at FM 1322	3.2	BFBA		22	22	22	22				
12645	Plum Creek at Young Lane (CR 197)	3.2	BFBA		22	22	22	22				
12648	Plum Creek at CR 186	3.2	BFBA		22	22	22	22				
12649	Plum Creek at CR 233	3.2	BFBA		22	22	22	22				
14945	Clear Fork Plum Creek at Old Luling Road (CR 213)	3.2	BFBA		22	22	22	22				
18343	Plum Creek Upstream of US 183	3.2	BFBA		22	22	22	22				
20480	Plum Creek Downstream of NRCS 1 Spillway	3.2	BFBA		22	22	22	22				
20481	Bunton Branch at Heidenreich Lane	3.2	BFBA		22	22	22	22				
20482	Brushy Creek at FM 2001 (Downstream of NRCS 12)	3.2	BFBA		22	22	22	22				
20489	Cowpen Creek at Schuelke Road	3.2	BFBA		22	22	22	22				
20496	Tenney Creek at Tenney Creek Road	3.2	BFBA		22	22	22	22				
20490	Clear Fork Plum Creek at Farmers Road	3.2	BFBA		22	22	22	22				
20493	Clear Fork Plum Creek at PR 10 (State Park)	3.2	BFBA		22	22	22	22				
20497	West Fork Plum Creek at FM 671	3.2	BFBA		22	22	22	22				
12538	Andrews Branch at CR 131	3.2	BFBA		22	22	22	22				
20495	Dry Creek at FM 713	3.2	BFBA		22	22	22	22				

TCEQ Station ID	Site Description	Workplan Task	Monitor Type	DO 24hr	Bacteria	Conventional	Flow	Field	AQHab	Benthics	Nekton	Comment
20484	Plum Creek at Heidenreich Lane (Downstream of Kyle WWTP)	3.2	BFBA		22	22	22	22				
20501	Salt Branch at Salt Flat Road (Upstream of Luling WWTP)	3.2	BFBA		22	22	22	22				
20498	Copperas Creek at Wattsville Road (CR 140, Downstream of Cal-Maine)	3.2	BFBA		22	22	22	22				
20505	Richmond Branch at Dacy Lane	3.2	BFBA		22	22	22	22				
20503	Plum Creek at Lehman Road	3.2	BFBA		22	22	22	22				
20502	Bunton Branch at Dacy Lane (upstream of NRCS 5)	3.2	BFBA		22	22	22	22				
20479	Unnamed Tributary at FM 150 near Hawthorn Dr.	3.2	BFBA		22	22	22	22				
20492	10210-001 City of Lockhart and GBRA #1(Larremore plant)	3.4	-		33	33	33	33				2
20494	10210-002 City of Lockhart and GBRA #2 (FM 20 plant)	3.4	-		33	33	33	33				2
20499	10582-001 City of Luling	3.4	-		33	33	33	33				2
20486	11041-002 City of Kyle and Aquasource Inc.	3.4	-		33	33	33	33				2
99923	11060-001 City of Buda and GBRA	3.4	-		33	33	33	33				2
99936	14431-001 GBRA Shadow Creek	3.4	-		33	33	33	33				2
99937	14377-001 GBRA Sunfield	3.4	-		33	33	33	33				2
20509	Lockhart Springs	3.5	BSWD		11	11	11	11				
20507	Clear Fork Springs at Borchert Loop (CR 108)	3.5	BSWD		11	11	11	11				
20508	Boggy Creek Springs at Boggy Creek Road (CR 218)	3.5	BSWD		11	11	11	11				

1. The seven "routine" sites double as "targeted" sites. "Targeted" sampling will collect biased flow (BF) samples twice per quarter – once under wet weather conditions and once under dry weather conditions. Whether these samples will satisfy the wet (biased high flow) or dry (biased low flow) weather conditions depends on the flow condition when samples are collected during the "routine' sampling that quarter.
2. The data collected from WWTF sampling will not be used for enforcement or compliance monitoring by TCEQ. As such, results will not be reported to TCEQ for inclusion in SWQMIS. Monitor type code is not applicable.
3. These samples are collected/analyzed by GBRA utilizing Texas CRP funding and serve as a portion of the non-federal match for this project. This project may collect additional monitoring at this station to cover lapses in the CRP data collection effort.

Appendix B Field Data Sheet

GBRA Field Data Reporting Form

LIMS Sample ID(s):

COLLECTOR (First Initial & Last Name)

STATION ID SEGMENT REGION DATA SOURCE

Station Description

GRAB SAMPLE

M M D D Y Y Y Y — Date
H H M M — Time
DEPTH
M = Meters
F = Feet

COMPOSITE SAMPLE

COMPOSITE CATEGORY: T = TIME S = SPACE B = BOTH F = FLOW WEIGHT

M M D D Y Y Y Y — START DATE
H H M M — START TIME
START DEPTH
M = Meters
F = Feet

M M D D Y Y Y Y — END DATE
H H M M — END TIME
END DEPTH (DEEPEST)
M = Meters
F = Feet

COMPOSITE TYPE: ## = Number of Grabs in Composite CN = Continuous

00010		WATER TEMP (°C only)
00400		pH (s. u.)
00300		D. O. (mg/L)
00094		SPECIFIC COND (µmhos/cm)
00480		SALNIITY (ppt, marine only)
00078		Transparency, SECCHI (meters)
00051		RESERVOIR ACCESS NOT POSSIBLE (Enter 1 if Reporting)*
00052		RESERVOIR STAGE (feet above mean sea level)*
00053		RESERVOIR PERENCT FULL (%)*

72053		Days Since Last Significant Precipitation			
01351		FLOW SEVERITY		1-no flow	2-low
		3-normal	5-high	4-flood	6-dry
00061		INSTANTANEOUS STREAM FLOW (ft^3/sec)			
89835		FLOW MEASUREMENT METHOD 1-FlowGage Station 2-Electric 3-Mechanical 4-Wier/Flume 5-Doppler			
74069		FLOW ESTIMATE (ft^3/sec)			
82903		DEPTH OF BOTTOM AT SAMPLE SITE (meters)*			
89864		MAXIMUM POOL WIDTH (meters)*			
89865		MAXIMUM POOL DEPTH (meters)*			
89869		POOL LENGTH (meters)*			
89870		% POOL COVERAGE IN 500 Meter REACH (%)			

*Parameters related to data collection in perennial pools; i.e., Flow Severity of 1 and Flow of 0 cfs reported.

Measurement Comments and Field Observations:

Appendix C Chain of Custody Form

GBRA LAB
933 E. Court Street, Seguin, TX 78155
Phone: (830) 379-5822 Fax: (830) 379-7478

GUADALUPE-BLANCO RIVER AUTHORITY LABORATORY
CHAIN OF CUSTODY

Customer Information

Customer Acct.#:	RUSH Analysis :_____________ by EOB (Additional Fees Apply)	
Name:	Billing Address:	
Address:	Fax #:	
Phone #:	Email 1:	
Thermometer #:	Email 2:	
Receipt Temp (°C) Observed / Corrected: /	Chlorine Strip GBRA Reagent #	Chlorine : Absent/ Present
Ice: Yes / No (Circle One)	pH Paper GBRA Reagent #:	
# of Containers: Condition of Containers (Intact): Yes / No (Circle One)	Residual Chlorine (Total/Free) Results:	

Date Collected	Time Collected	Matrix WW=Wastewater DW=Drinking Water SW=Surface Water S=Soil/Sludge	Sx Vol. P=Plastic G=Glass	Sample Name/Description	TCEQ ID Number	Grab / Comp.	Analysis Requested	GBRA Sample ID	Bottle I.D.#	pH	Type of Preservation	Rush sample (2x, 3x, 4x)

Collected By:	Date/Time:	Transferred To:	Date/Time:
Released From:	Date/Time:	Received By:	Date/Time:
Released From:	Date/Time:	Received By:	Date/Time:
Released From:	Date/Time:	Received By:	Date/Time:
Released From:	Date/Time:	Received By:	Date/Time:
NOTES / COMMENTS / SHIP TO:			

RL-042/COC-0101/TWG-6000/2011 (QASM App. c) GBRA Doc. 3019-C Rev 18 Eff: 07/09/2018 MMR

Appendix D Data Summary Report

Data Review Checklist

This checklist is to be used by the GBRA and other entities handling the monitoring data in order to review data before submitting to the TSSWCB & TCEQ. This table may not contain all of the data review tasks being conducted.

Data Format and Structure	Y, N, or N/A
Are there any duplicate Tag Id numbers in the Events file?	
Do the Tag prefixes correctly represent the entity providing the data?	
Have any Tag Id numbers been used in previous data submissions?	
Are Tag IDs associated with a valid SLOC?	
Are sampling Dates in the correct format, MM/DD/YYYY with leading zeros?	
Are sampling Times based on the 24 hr clock (e.g. 09:04) with leading zeros?	
Is the Comments field filled in where appropriate (e.g. unusual occurrence, sampling problems, unrepresentative of ambient water quality)?	
Are Submitting Entity, Collecting Entity, and Monitoring Type codes used correctly?	
Do sampling dates in the Results file match those in the Events file for each Tag Id?	
Are values represented by a valid parameter code with the correct units?	
Are there any duplicate parameter codes for the same Tag Id?	
Are there any invalid symbols in the Greater Than/Less Than (GT/LT) field?	
Are there any Tag Ids in the Results file that are not in the Events file or vice versa?	
Data Quality Review	Y, N, or N/A
Are "less-than" values reported at the LOQ? If no, explain in Data Summary.	
Have the outliers been verified and a "1" placed in the Verify_flg field?	
Have checks on correctness of analysis or data reasonableness been performed? e.g., Is ortho-phosphorus less than total phosphorus? Are dissolved metal concentrations less than or equal to total metals? Is the minimum 24 hour DO less than the maximum 24 hour DO? Do the values appear to be consistent with what is expected for site?	
Have at least 10% of the data in the data set been reviewed against the field and laboratory data sheets?	
Are all parameter codes in the data set listed in the QAPP?	
Are all stations in the data set listed in the QAPP?	
Documentation Review	Y, N, or N/A
Are blank results acceptable as specified in the QAPP?	
Were control charts used to determine the acceptability of lab duplicates (if applicable)?	
Was documentation of any unusual occurrences that may affect water quality included in the Event file's Comments field?	
Were there any failures in sampling methods and/or deviations from sample design requirements that resulted in unreportable data? If yes, explain in Data Summary.	
Were there any failures in field and/or laboratory measurement systems that were not resolvable and resulted in unreportable data? If yes, explain in Data Summary.	
Was the laboratory's NELAP Accreditation current for analysis conducted?	
Did participants follow the requirements of this QAPP in the collection, analysis, and reporting of data?	

Data Summary

Data Set Information

Data Source: ______________________________

Date Submitted: ______________________________

Tag_id Range:
____

Date Range:
____

□ I certify that all data in this data set meets the requirements specified in Texas Water Code Chapter 5, Subchapter R (TWC §5.801 et seq) and Title 30 Texas Administrative Code Chapter 25, Subchapters A & B.
□ This data set has been reviewed using the criteria in the Data Review Checklist.

Planning Agency Data Manager: ______________________ Date: __________

Please explain in the table below any data discrepancies discovered during data review including:

- Inconsistencies with LOQs
- Failures in sampling methods and/or laboratory procedures that resulted in data that could not be reported to the TCEQ (indicate items for which the Corrective Action Process has been initiated and send *Corrective Action Status Report* with the applicable Progress Report).

Dataset ____ contains data from FY___ QAPP Submitting Entity code ___ and collecting entity ___. This is field and lab data that was collected by the (collecting entity). Analyses were performed by the (lab name). The following tables explain discrepancies or missing data as well as calculated data loss.

Discrepancies or missing data for the listed tag ID:

Tag ID	Station ID	Date	Parameters	Type of Problem	Comment/PreCAPs/CAPs

Data Loss

Parameter	Missing Data points out of Total	Percent Data Loss for this Dataset	Parameter	Missing Data points out of Total	Percent Data Loss for this Dataset